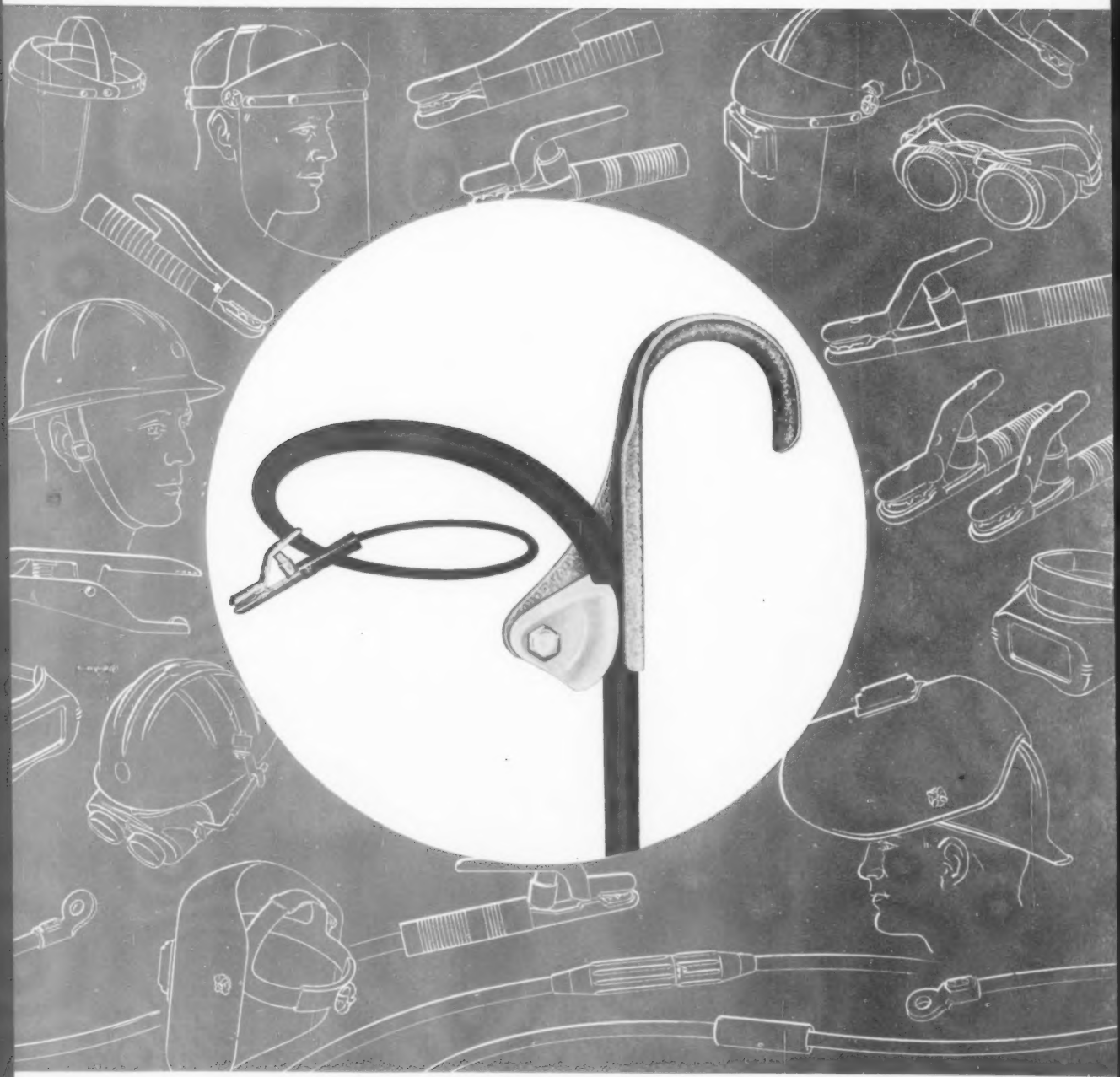
Welding Engineer

PRICE 50 CENTS

OCTOBER, 1958



For welding in high places, the new Jackson Cablehitch, hooked to a support near the work area, carries the cable running down to the machine. It allows the cable to be pulled through, but prevents it from slipping back. It frees the operator from cable weight and cable drag, saves wear on cable and cable connections.

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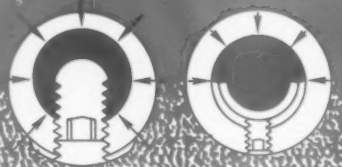

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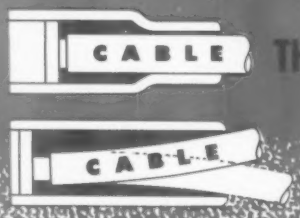

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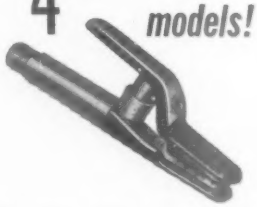

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How semi-automatic hard surfacing saves time and material at Bradford Hills Quarry

"Changing to the semi-automatic application of nickel manganese surfacing material almost saved us the price of the Wear-O-Matic machine in just five weeks," says Thomas Risbon, Welding Foreman for Bradford Hills Quarry, East Petersburg, and Downingtown, Pa.

The Wear-O-Matic unit at Bradford Hills Quarry is used almost exclusively for maintaining their new 57-60 Universal Impactor. Over a five week period, nightly maintenance on this crusher required 500 pounds of 7/64" Wear-O-Matic nickel manganese wire to provide normal operating tolerances. During a similar period, 800 pounds of ¼" nickel manganese stick electrodes were required to provide the same amount of wear protection to the impactors.

Savings in maintenance operations in your industry are important because they affect profits. Find out how the Wear-O-Matic process can help lighten your maintenance load. It's built right and priced right* to provide for you the most efficient maintenance on all equipment subject to wear. Request Bulletin HS-102 Alloy Rods Company, P. O. Box 1828, York, Pennsylvania.

From this platform on the crusher, the Wear-O-Matic unit is used nightly to maintain proper impactor size for most efficient operation.

Weldor Gene Johnson says, "It's easy to turn out square edged impactors like this with the Wear-O-Matic process and, it's less tiring than stick electrodes."

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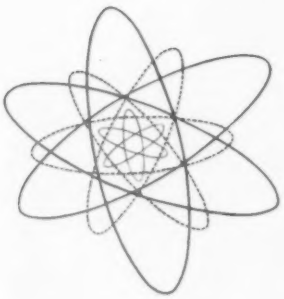
Vol. 43 — No. 10

Welding Engineer

The magazine of joining and severing materials

This is welding: October, 1958



A guide to nuclear power 36

As welding's role in the atomic present and the nuclear future continues to grow in importance, basic principles of nuclear power must be understood and are described in this first article in a series by **W. D. Briggs.**

ABC's of weld estimating 39

Accurate estimates of welding time are an integral and important part of the total welding fabrication picture and should be treated as such, according to this detailed explanation by **Clement F. Brown.**

Resistance welding procedures and design 44

Lester F. Spencer's first article in a series describes the functions of resistance welding equipment commonly used to join commercially available materials, and the controls which enable this equipment to perform its job with accuracy and reliability.

Filler metals for joining 48

Orville T. Barnett discusses in detail the basic types of tungsten electrodes used in Tig welding, including their chemical analyses and welding properties in this 17th article in a series.

Ultrasonics: tool of the future 52

Degreasing, welding, weld inspection and shop decontamination are listed as some of the uses of ultrasonic sound waves as this modern welding process begins taking giant steps in the welding industry.

Unusual design guarantees clear view of sports 56

Modern welded haunches replace ancient flying buttresses in building construction to guarantee an unobstructed view, and to provide cost and space savings, reports **E. A. Moenning.**

Welding makes these tanks "Superior" 58

Fel Tancula covers the step by step fabrication of storage tanks, from roll-forming to edge preparation to welding, by a Southern manufacturer who believes in making his products conform to the company name.

Weld quality without guess-work 74

Welding consultant **Ned Nyberg** documents the history of a change from manual to mechanized welding procedures in a plant producing a diversity of product styles and sizes.

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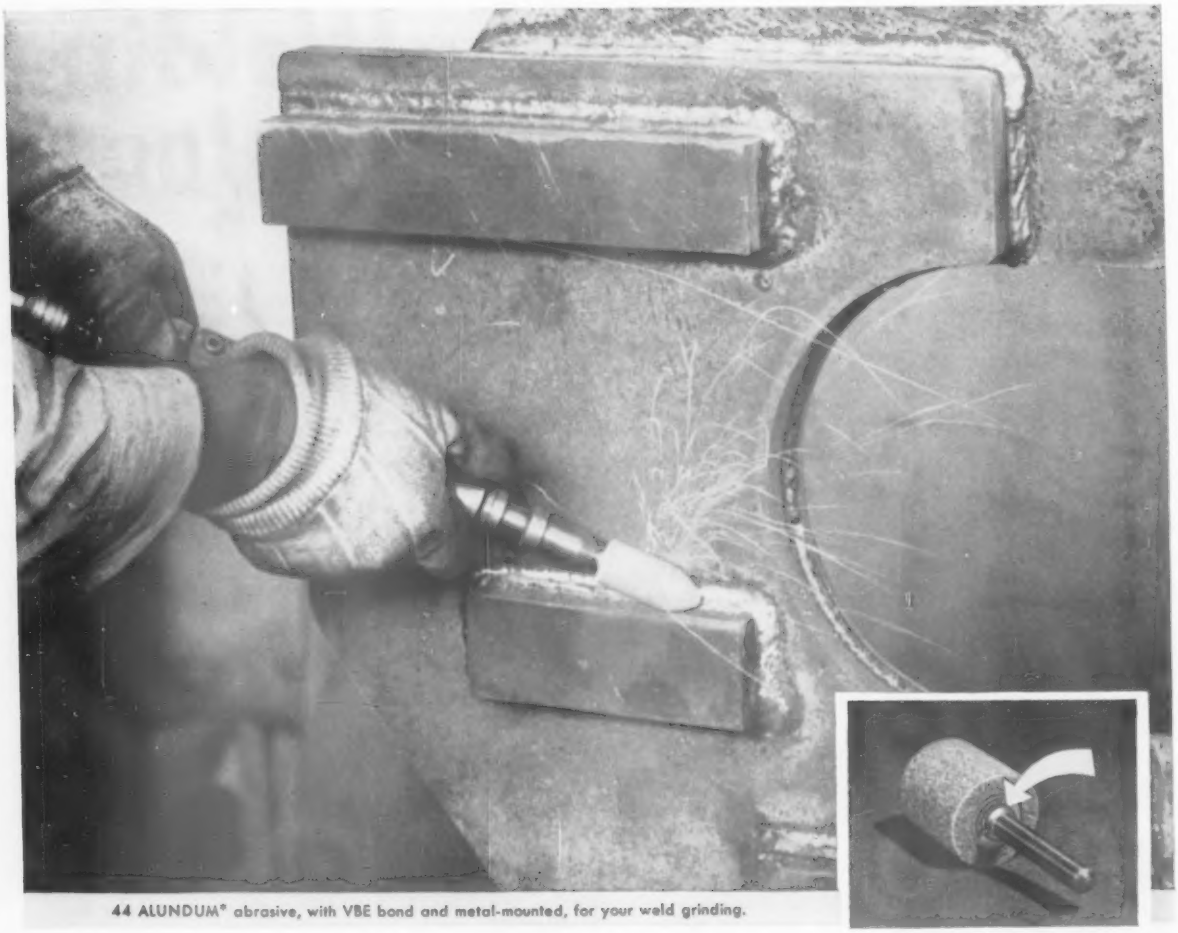

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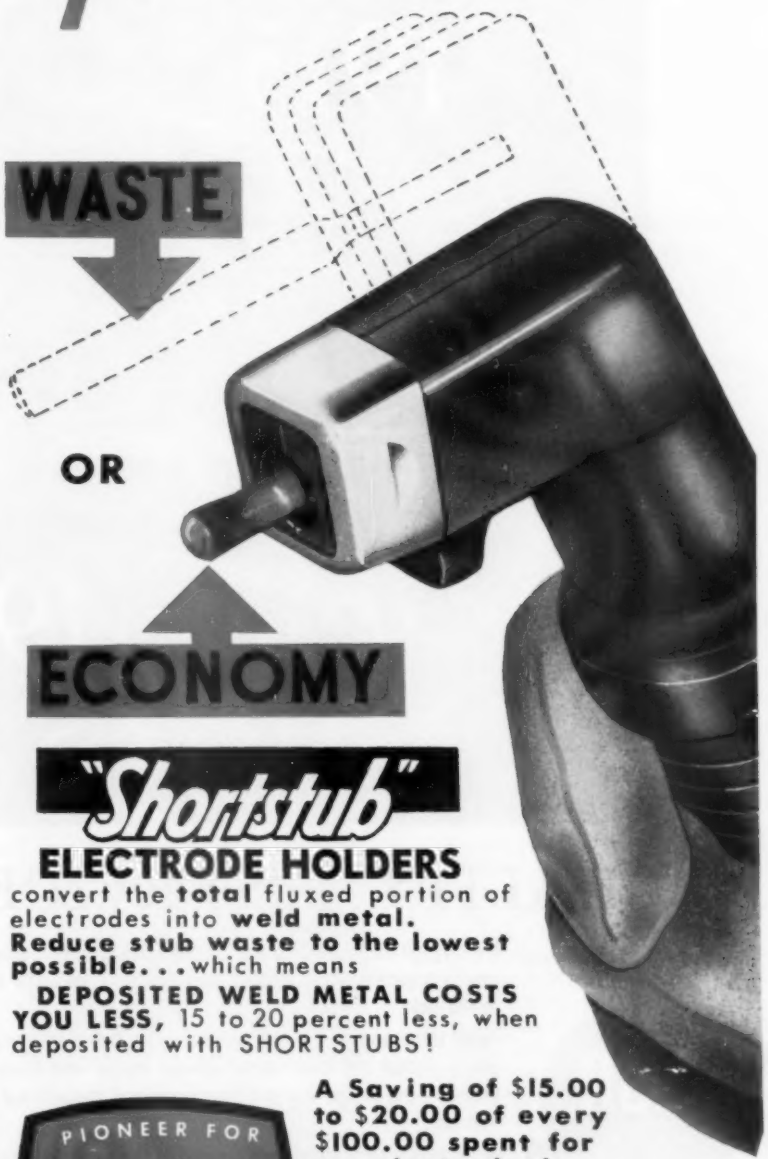
WELDING ENGINEER is indexed regularly by Engineering Index, Inc.

Which do you have?



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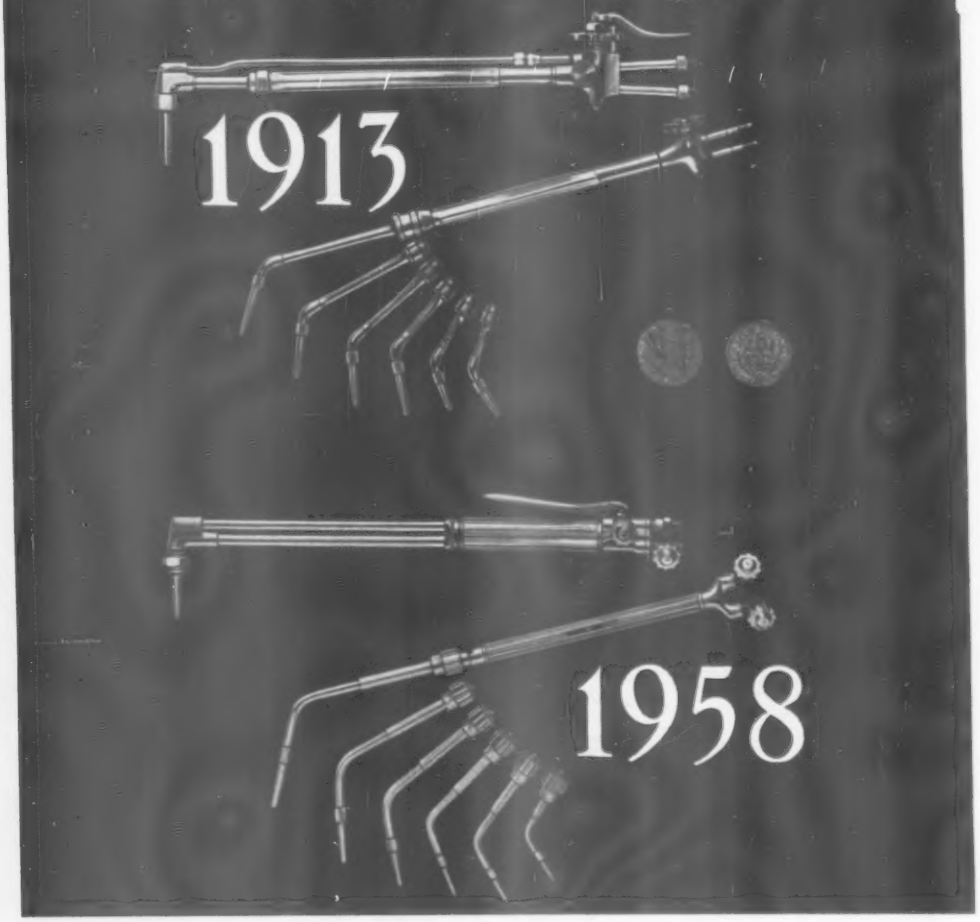


QUALITY . . . SERVICE

the original Victor welding and cutting torches were created in 1913 to fill the need for better and safer equipment—torches that were practical, versatile and built to last—created to be a victor in the field.

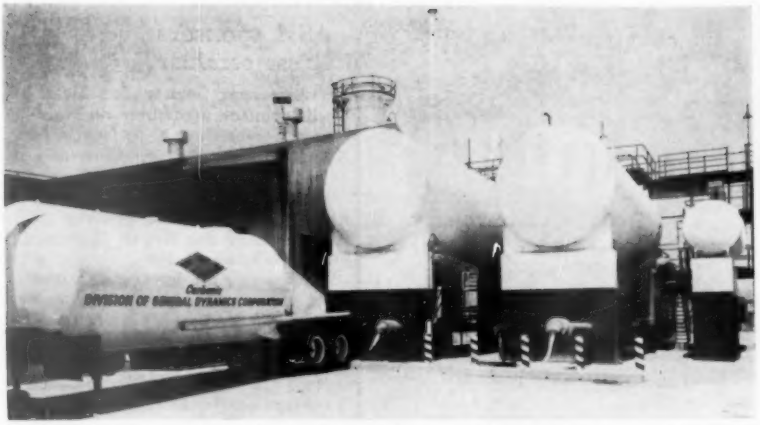
Victor torches were an immediate success—they were designed with the user in mind by L.W. Stettner, a skilled and experienced pioneer welder who knew the needs of the men who work with torches—the design was so efficient and well thought out that few changes have been made since that time.

VICTOR for welding

Victor safety regulators were created in the same pattern—to fill the need for safe, reliable, and practical equipment for the man in the field.

the success and popularity of Victor today is solidly based on the application of those principles under active leadership of the original inventor and founder.

VICTOR EQUIPMENT COMPANY *SAN FRANCISCO LOS ANGELES CHICAGO*



NEW $1,600,000 Liquid Carbonic plant produces liquid oxygen, nitrogen and argon. Tanks shown are vacuum insulated and hold liquid oxygen at —298 F, liquid nitrogen at —320 F, and liquid argon at —310 F.

Liquid Carbonic dedicates two industrial plants

Liquid Carbonic Div., Chicago, of General Dynamics Corp., New York City, has dedicated two new industrial plants in the San Francisco Bay area.

The new plants, one in Oakland for the manufacture of liquid oxygen, nitrogen and argon, and one in San Carlos for the manufacture of electrolytic hydrogen and oxygen represent a total investment of $4,000,000.

Rex L. Nicholson, senior vice president, Liquid Carbonic Div., told a group at the dedication ceremonies most of the current output of the Oakland plant will be used by the government in rocket and missile programs, such as General Dynamic's Atlas Missile.

The Oakland plant, a 9,000 sq ft rigid frame building with steel walls and roof, will produce more than 30 tons of liquid oxygen, nitrogen, and argon daily. Materials will also be used by the steel, oil, electric, chemical and construction industries, in addition to the military programs.

As a sidelight, Nicholson stated the medical profession is second only to the metals industry as a consumer of oxygen in the United States.

In addition to plant facilities at San Carlos, regional offices were also built. Total area of plant and offices is approximately 15,000 sq ft. The office building is reinforced concrete and stucco construction with rigid frame, steel walls and roof. Plant will produce hydrogen and oxygen gases at daily rate of 5,000,000 cu ft.

Frank L. Pace, Jr., president of General Dynamics Corp., spoke at the dedication of both plants.

Founded in 1888, Liquid Carbonic Corp. merged with General Dynamics last year.

TANKS where, by electrolytic action, hydrogen and oxygen are removed from water containing trace of electricity-conducting caustic acid. (See story.)

Eutectic opens Ohio warehouse-service center

A warehouse-service center to serve Columbus area industry has been established by Eutectic Welding Alloys —Ohio Valley Div., Inc.

The free industrial shop consultation-demonstration service of company technical representatives will be coordinated by V. J. Ridgway, manager.

Center will be only source of company's low-temperature welding alloys, and headquarters for technical information service.

NEWS

Welding engineering scholarships presented

George K. Hickox, Waukegan, Ill., received the first $3,000 Air Reduction Fellowship in welding engineering at Ohio State University.

The fellowship was established last year by Air Reduction Co., Inc., New York City, to encourage graduate study and research in welding engineering.

Hickox, an ex-air Force gunner-mechanic, will do research in the interpretation of fusion weld quality from xeroradiographic images. He is in his fifth year of study at the university, and expects to receive both his bachelor's and master's degrees in 1959.

An Ohio State University scholarship of $250 was awarded Harry L. Heckler, a senior in welding engineering. The annual scholarship, established in 1942 by an anonymous donor, is awarded on the basis of scholastic record and professional possibilities.

Heckler, married and the father of two children, was president of the student chapter of the American Welding Society last year.

Robotron 10th year marked by expansion

Robotron Corp., Detroit manufacturer of electronic industrial controls and induction heating units, is celebrating its 10th anniversary with overseas expansion.

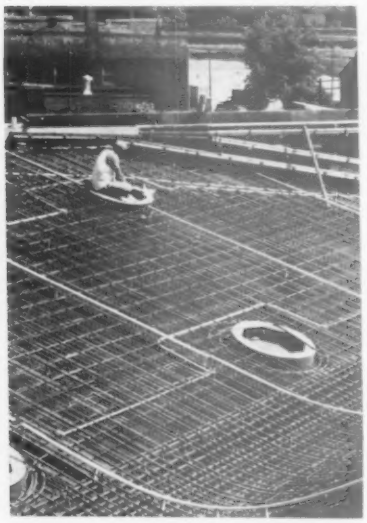
The company recently announced that licensed manufacturing and sales facilities to serve international markets have been extended. Radiovisor Parent Ltd., High Path, London, England, will handle industrial markets in the British Isles and Europe. England and Electrical Control & Engineering Ltd., Camperdown, Sydney, Australia, will cover industry in their country, New Zealand and Asia.

Robotron products include a line of resistance-welding controls, automatic arc-welding controls, proximity switches and time-delay relays.

CB&I opens KC office

A district sales office at 7926A Stateline Road, Kansas City, Mo., has been opened by Chicago Bridge & Iron Co.

ALL-STATE building in White Plains, N. Y. New addition is wing shown at left. (See story.)



ROOF of St. Francis de Sales high school in Chicago prior to concrete pour. Note placement of reinforcing bars which were pre-fabricated by U. S. Steel Supply Div., Chicago. Completed roof is concrete shell 4½-in. thick at each arch covering unobstructed gymnasium floor area of 15,000 sq. ft. Note network of welded wire.

All-State to have west coast plant

All-State Welding Alloys Co., Inc., White Plains, N. Y., will begin the manufacture of welding electrodes at a South Gate, Calif., plant.

Coils of extruded aluminum wire will be shipped from the manufacturer's Connecticut wire plant to South Gate where all conversion operations to make the wire into welding electrodes will be done.

All-State also recently completed an addition, pictured above, to their White Plains, N. Y., plant.

Belgian World Fair trip awarded contest winner

John J. Chyle's suggestion to use microbeads (tiny glass beads with diameters as small as one micron) in electrode coatings has won him a two-week paid trip to the Belgian World Fair, Brussels.

Chyle, of A. O. Smith Corp., and an AWS past president, was among 751 persons who entered "Jobs for tomorrow," a contest sponsored by Microbeads Inc., Toledo, Ohio, to find job-creating uses for a new material.

ONE of four welded turbine scroll cases to be built by Chicago Bridge and Iron Co. for the Noxon Rapids Dam project in Montana. Scroll was first built in CB&I's Chicago plant, then dismantled, shipped by rail to the dam site, and reconstructed by a company crew. (See story at right.)

ASM sponsors stress seminar

American Society for Metals will sponsor a seminar on residual stresses Oct. 30 to Nov. 1 in Wade Park Manor, Cleveland.

Lecturer will be Richard Weck, professor at Cambridge University, England, and director of research of the British Welding Research Association.

Eleven American authorities on gears, welded structures and warpage and heat treatment problems will participate in the seminar. Included in this group are Julius Heuschkel, consulting welding engineer, research laboratories, Westinghouse Electric Corp., Pittsburgh; Leo P. Tarasov, research and development, Norton Co., Worcester, Mass.; and Dr. LaMotte Grover, Air Reduction Co., New York City.

Honorary chairman for the seminar will be J. O. Almen, Los Angeles, retired General Motors Research Laboratories scientist.

NCG absorbs Montana subsidiary

Home Oxygen Co., Billings, Mont., has been dissolved and is now operating under the name of National Cylinder Gas Div. of Chemetron Corp. The plant, which produces acetylene and high-purity oxygen, became an NCG subsidiary in 1955.

New Linde hydrogen plant in operation

Linde Co. is now operating a high-purity hydrogen plant at Linden, N. J. The plant is on land rented from General Aniline and Film Corp., which will supply the crude hydrogen for processing. The majority of the processed hydrogen will be used in the electronics and pharmaceutical industries, and for hydrogenation and food processing.

CB&I turbine scroll shipped to Montana

Chicago Bridge & Iron Co., Chicago, has built and shipped one of the largest welded turbine scroll cases in the United States. The scroll is at the site of the Noxon Rapids Dam in western Montana.

The 24-ft diameter scroll case was shop fit in the company's Chicago plant, and then dismantled and shipped in sections. The sections were welded at the dam site by a CB&I crew.

High strength T-1 alloy steel was used in the scroll's construction, re-

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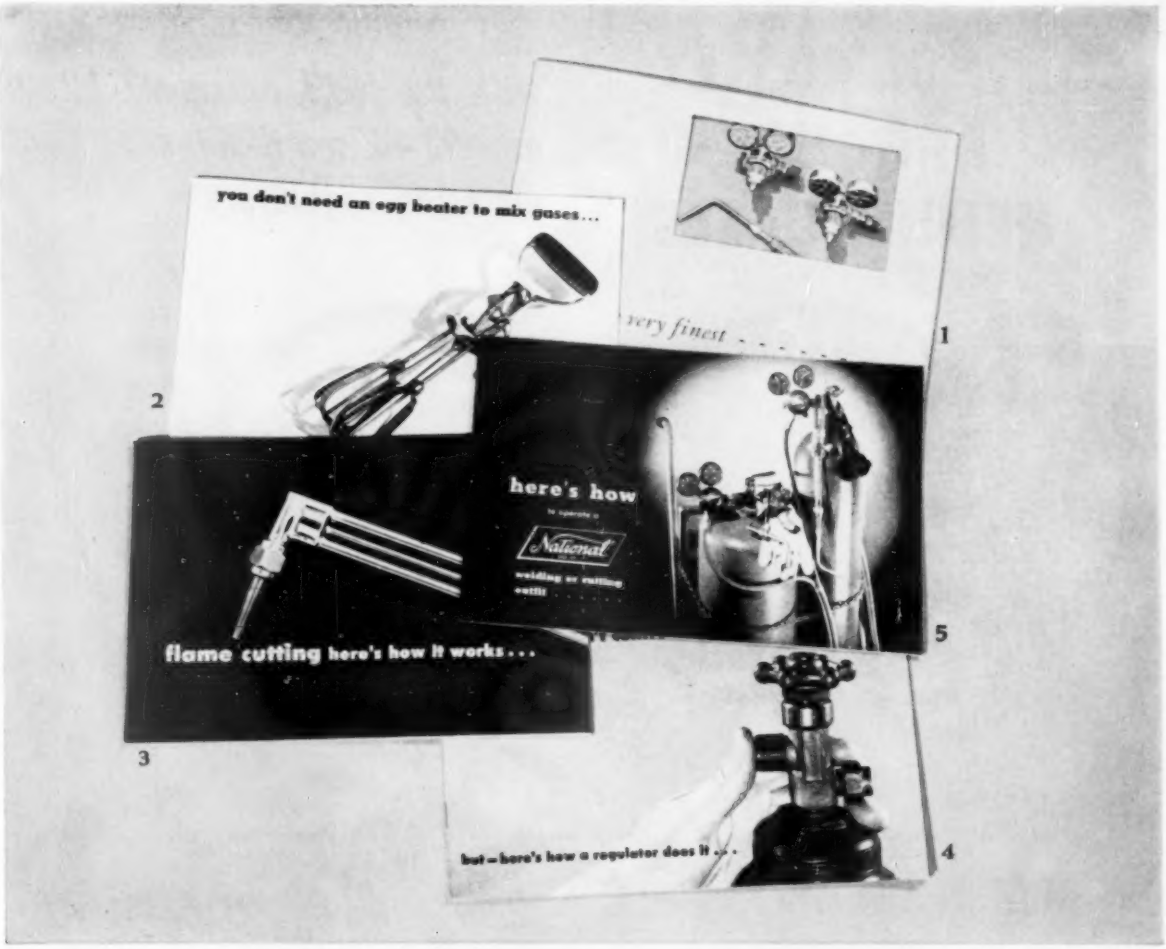

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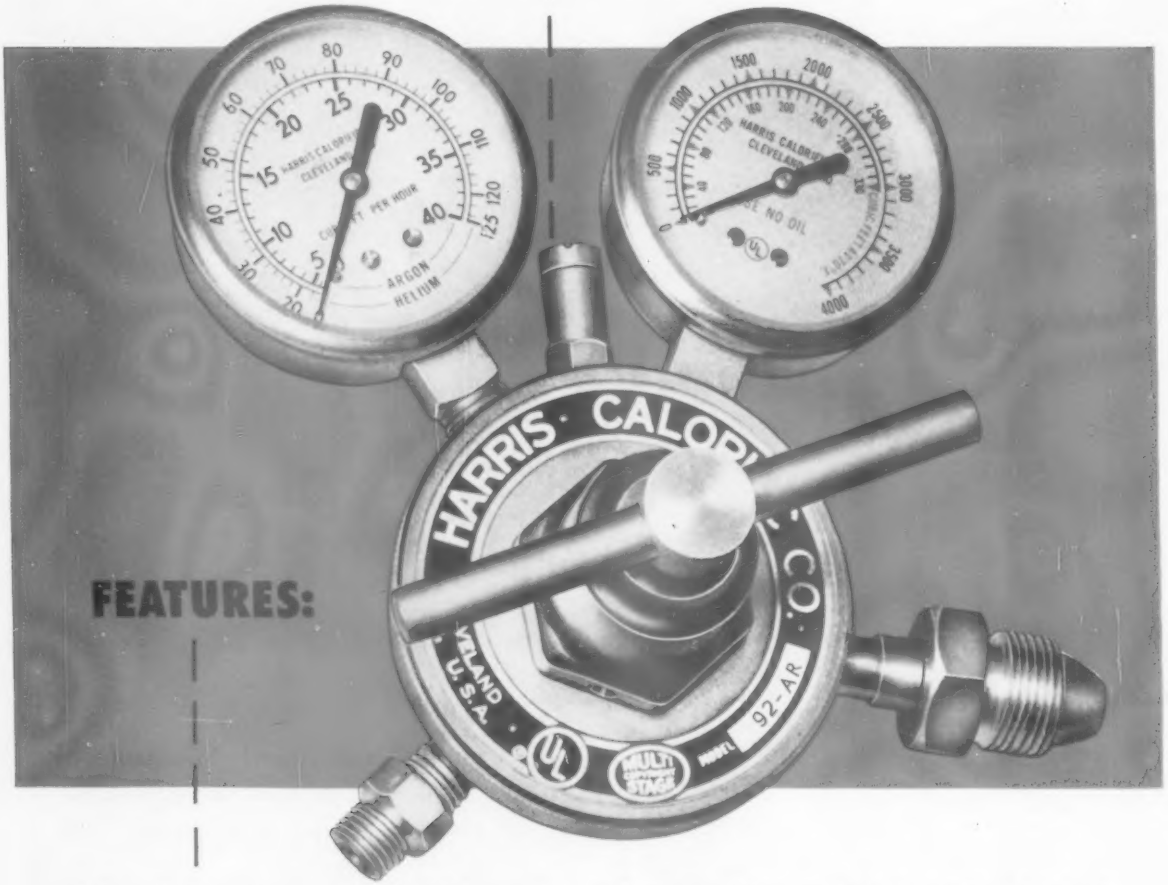

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- REDUCES FATIGUE
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Dockson again leads the field with the first real improvement in welding torch design in years. The "Levermatic" was designed especially for improved operating efficiency and comfort. Once adjusted to the operators satisfaction it can be turned off and on with the flick of a thumb, always in identical adjustment.

Light pressure on the lever increases flame from pilot to work adjustment and locks in position—a flick and its back to pilot. No cramping hand tension. No readjusting or relighting. No wasted gas. It takes the fuss and fumble out of welding.

There's a Dockson Distributor near you. Ask him to demonstrate the "Levermatic" in your shop.

Dockson has a complete line of quality welding and cutting equipment for every use. Ask for our new Welding Catalog No. 58W.

LEVERMATIC
MODEL 3E
For light to one inch welding,
Length 18″.

LEVERMATIC MODEL 3BB
For light to one inch welding,
Length 13″.

LEVERMATIC MODEL 3EV
For light welding, Length 13″.

Dockson CORPORATION

3939 WABASH AVENUE • DETROIT 8, MICHIGAN

OCTOBER
1958

Your

Weld World

at press time

Last minute news of interest to those engaged in joining and severing materials.

. . Watch for developments in electron-beam welding, whereby refractory and rare metals are joined in vacuum by heat from electrons emitted by modified X-ray tube. At least one firm, G-E X-Ray Dept., is welding such materials in its laboratory.

. . Westinghouse will soon introduce new C-P arc welder for semiautomatic and automatic applications which will cut welding-current requirements considerably. Other claims: it will eliminate spatter, make possible joining thin-gage materials in all positions.

. . Another Westinghouse product on horizon: electronically timed arc spot gun that will be competitive with resistance units.

. . Weldable aluminum that floats because it is "bubbled" was unveiled at chemical show in Chicago last month.

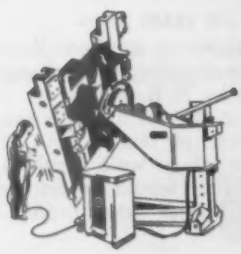
. . National Welded Products month, originated and promoted by WELDING ENGINEER, in the future will be a "week" jointly sponsored with American Welding Society. In 1959, it will be week of April 5, to coincide with annual welding show.

. . "TVX" is new X-ray production equipment unveiled by General Electric on Sept. 10. A closed-circuit television image intensification system, it offers 100% production line quality control X-ray inspection of products with fluoroscopy 10,000 times brighter than ever before possible, says G-E.

. . Air Reduction Sales Co. is planning oxygen facility adjacent its present Butler, Pa., plant to supply Butler Works of Armco Steel Corp. Daily capacity: 120 tons. Expansion program just completed at Airco's Lorain, Ohio, plant, has boosted daily production of gaseous and liquid oxygen there from 40 to 100 tons.

. . After several cutbacks, Phelps Dodge Corp. is boosting copper production. Several other firms have also hiked output, most increases resulting from a longer work week. Copper prices continue to see-saw on all fronts.

. . Stud welding of aluminum, long a challenge to industry, may soon become commonplace. Nelson Stud says it is successfully welding aluminum studs through ½-in. diameter. Potential markets: shipbuilding, missile and fabrication industries.



. . Quartz tubing 3/1,000's of an inch in diameter is being produced by Monsanto Chemical Co. An example of industrial application: in Bell Labs' development for recovering helium now lost in natural gas. Heart of the diffusion cell in Bell process is this "Santotube Q," used as capillary tubing.

. . Linde Co. has installed oxygen plant at U. S. Steel Corp.'s Gary, Ind., Works. Monthly capacity: 94 million cubic feet.

A LEADER

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"REDUCING COSTS BY PROPER CARE OF
ARC WELDING CIRCUITS"

LENCO, INC.

350 W. ADAMS ST. JACKSON, MO.

30 YEARS AGO

(Taken from the *Welding Engineer* of October, 1928)

An arc welded bridge is the subject of an article by A. G. Bissell, arc welding engineer for Westinghouse Electric & Mfg. Co. Outlined are the design, erection procedure and cost data on a 50-ft railway bridge at Turtle Creek, Pa.

—30 YEARS AGO—

The importance of oxyacetylene welding in the construction of commercial aircraft is discussed in "Welding in aircraft construction." Welding of a plane's fuselage is extensively covered.

—30 YEARS AGO—

A news item tells of the beginning of construction of a building in the Cleveland shopping district in which welding will replace punching and riveting. A strong point in favor of arc welding is the silence it affords during construction.

—30 YEARS AGO—

The Stoody Co., Whittier, Calif., recently purchased a Fokker Special six-passenger cabin monoplane for business purposes.

—30 YEARS AGO—

Welding on railway cars reduces the cost of production 20% and the cost of maintenance 80% explains R. L. Scollard in an article.

—30 YEARS AGO—

Houston, Tex., convention city and gulf port, has constructed three hangars at its airport to accommodate its flying guests. The hangars are all-metal, with corrugated sheet metal covering an arc-welded superstructure.

—30 YEARS AGO—

The 42-story Grant Building in Pittsburgh, Pa., has open-web bar joists welded to the floor beams of all above-street floors. Each joist is welded to supporting beams with a ¾-in. long weld on both sides.

—30 YEARS AGO—

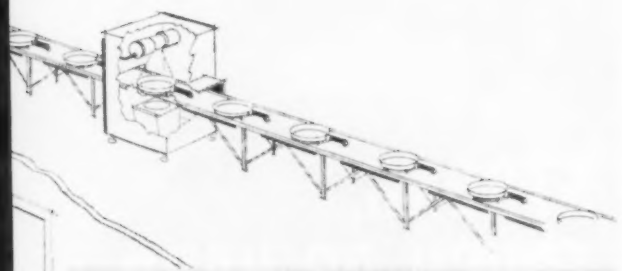
The future of applied X-rays and its possibilities is described in an article by H. R. Isenburger. He says, "It is certain that if a reliable method of determining the soundness of a weld could be used, welding would be adopted to a much larger extent than it is at present."

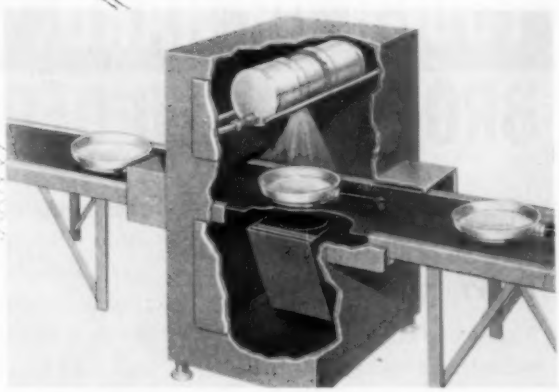
General Electric
x-ray
in industry

Now from G.E.—X-Ray inspection through closed-circuit television!

TVX

X-ray Image Intensification System





Permits viewing from remote locations...

A fabulous "first" from G.E.! TVX combines the speed of a fluoroscope, the flexibility and bright image of television. Allows continuous 100% inspection from any number of locations within 1400 feet of the monitor — in separate rooms, or even separate buildings.

The TVX monitor — designed to nest atop the control unit — has 12-in. picture tube, bright enough for easy viewing in normally lighted rooms. And should additional monitors be required for simultaneous viewing from multiple locations, any standard TV receiver will do.

Meanwhile, on the production line...

TVX camera picks up x-ray image of moving inspection line, covers a pickup field up to 6⅞-in. diameter. Image size can be varied electronically from ½ to 3 times that of the object, providing both magnification and image intensification.

Provides safety, too. Because the operator can be remote from the radiation area, any x-ray intensity needed for adequate penetration may be used. Power is furnished by a conventional x-ray generator.

TVX service is always promptly available from General Electric x-ray representatives in all major industrial areas.

For complete TVX specs and features data, see your G-E x-ray representative. Or write General Electric X-Ray Department, Milwaukee 1, Wis., Rm. AE-104.

OPERATION upturn — Build sales and jobs in '58 — GENERAL ELECTRIC

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Bare 36" Filler Rods for the TIG Process

5 grades to choose from—hardnesses from 160 to 380 Brinell.

Sound, free-flowing deposits join copper-, iron-, and nickel-base metals and alloys; dissimilar metals and alloys. Used extensively to overlay surfaces subject to excessive wear from metal-to-metal contact — or to shock. Resist the corrosive action of salt water, many acids and mild alkalies.

Ask your Ampco distributor to recommend the right Ampco-Trode filler rod for overlay, fabrication, and repair applications.

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WEST COAST PLANT: BURBANK, CALIFORNIA
SOUTHWEST PLANT: GARLAND (DALLAS COUNTY), TEXAS

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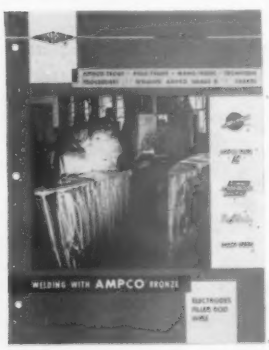

TEAR OUT COUPON — *and mail today for Bulletin W-17 that gives detailed information on Ampco-Trode filler rods and other electrodes.*

W-150

AMPCO METAL, INC.
Dept. 186J, Milwaukee 46, Wisconsin

Send me Bulletin W-17.

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Company _____

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Letters . . .

Letters should be addressed to: The Editor, WELDING ENGINEER, P. O. Box 28, Morton Grove, Ill. No letter will be published unless signed, but your name will be withheld if requested.

Not our error

Sir: *East Longmeadow, Mass.*

I see on page 8 of your September issue a picture of the welding on the aluminum mast for the *Columbia*.

Your story is correct in that the aluminum was extruded by the Aluminum Co. of America and the fabrication was paid-for by the Fuller Brush Co. of Hartford, Conn. However, the fabrication itself was done by Package Machinery Co., East Longmeadow, Mass. The bending to the dart and collapsing of the ellipsoidal top section was done at Package Machinery Co., as was the welding of the header and other fixtures.

The top section was transported to the Fuller plant, where it was set-up in the rotary jigs pictured. Package Machinery Co. supplied the welding engineer and technician, along with a Miller unit. The butt welding was done by Package Machinery Co. personnel in the Fuller plant in Hartford.

While I am in complete sympathy with the Fuller Co. getting full credit for paying for the mast, I would nevertheless like to correct an impression created in your story. Package Machinery Co. is a specialist in the fabricating of steel and non-ferrous material, with complete machine shop facilities for the subsequent machining of the welding.

We have taken a good bit of pride in the work that we did for this particular job, as well as others of a like nature, which required considerable ingenuity in order to achieve the results desired.

Roger L. Putnam, Jr.
Executive Vice-president

(Editor's note—Sorry about any mix-up, but the news release from Aluminum Co. of America stated, "The Columbia's mast was fabricated by the Fuller Brush Co. Machine Division.")

Congratulations

Sir: *Minneapolis*

Congratulations on your fine editorial on page 25 of your July issue. This is a dandy.

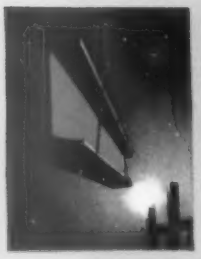
L. L. McBurney
Smith Welding Equip. Corp.

Sir: *Ecorse, Michigan*

Your Fact File issue (Mid-June, 1958) is very good indeed.

Fred A. Cosgro
Welding Instructor

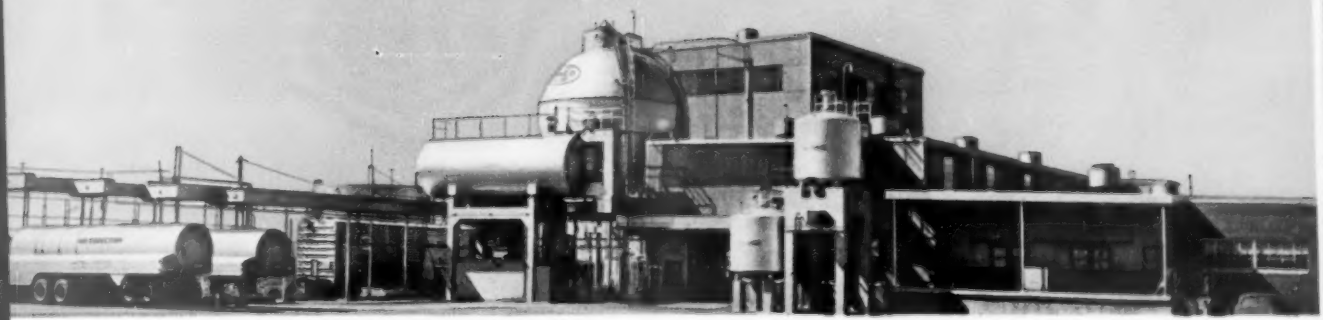
INDUSTRIAL GASES... NATIONWIDE... FROM AIRCO



Air Reduction gases, among them oxygen, nitrogen, argon, hydrogen, helium and carbon dioxide are vital commodities in the metal-working industries.

In other industries, too, Air Reduction gases are playing an important role—food processing, electronics, steel, aircraft and missiles, and chemicals.

To all industries, Air Reduction supplies gases in whatever quantity needed, and in whatever form—gaseous or liquid. (Except hydrogen—available in gaseous form only and helium also available in liquid form currently on West Coast only, elsewhere in gaseous form.) Air Reduction industrial gas specialists, with years of practical experience and technical training, are at your service to help you make the most efficient use of industrial gases. Ask the Airco representative in your vicinity to show you why your gas requirements are best served by Air Reduction.



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AT THE FRONTIERS OF PROGRESS YOU'LL FIND AN AIR REDUCTION PRODUCT • Products of the divisions of Air Reduction Company, Incorporated, include: AIRCO – Industrial gases, welding and cutting equipment • AIRCO CHEMICAL – vinyl acetate monomer, vinyl stearate, methyl butynol, methyl pentynol, and other acetylenic chemicals • PURECO–carbon dioxide–gaseous, welding grade CO_2, liquid, solid ("DRY-ICE") • OHIO–medical gases and hospital equipment • NATIONAL CARBIDE–pipeline acetylene and calcium carbide • COLTON–polyvinyl acetate, alcohols, and other synthetic resins.

WELD ANYWHERE

with the new Aircomatic® MIGet

(pronounced "midget")

The lightweight, versatile Aircomatic MIGet, for gas-shielded arc welding, operates 50 ft. from control panel, with control panel 100 yds. from power supply!

The MIGet carries its own drive rolls and one-pound reel of .030", .035", 3/64" or 1/16" aluminum wire; or two-pound reel of .030", .035" or .045" hard wire. Feed speed to 900 inches per minute . . . 200 amperes. DC. Air cooled. Gun, without reel, weighs about three pounds. Control cabinet, 17 pounds. Here is *THE* gun for short-length welds in hard-to-get-at places.

Send today for technical literature on the Aircomatic MIGet. Or phone your nearby Air Reduction Sales Office.

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"Baltospot is lightweight—the only completely portable 140-kv unit on the market. Ideal for inaccessible places."

E. E. Ellis says, "There's nothing to it. This unit will radiograph steel up to 1¾ inches thick."

"In less than a day I could teach anyone to make good inspection X-rays with BALTOSPOT,"

E. E. Ellis

J. B. Fisher

says E. E. Ellis, Welding Engineer and Radiographer, Fisher Tank Company, Chester, Pennsylvania. "One year of experience with Baltospot X-ray equipment proved to us that practically anyone can make good radiographs. There are just three simple steps:

1. measure thickness of part and refer to chart
2. make exposure
3. develop film according to chart

X-ray inspection keeps us on our toes and is far ahead of other methods."

Does Baltospot Pay?

"It certainly does," says J. B. Fisher, President, Fisher Tank Company. "We exercise better control over all phases of work, and save approximately 77 percent in radiography costs. Helping our welders maintain uniform high quality and developing new welding techniques are prime functions of this, the most effective means of testing welds."

Your Westinghouse X-ray Specialist has information on the full line of industrial radiographic-fluoroscopic equipment, or write: Westinghouse X-ray Department, 2519 Wilkens Avenue, Baltimore 3, Maryland. J-08369

YOU CAN BE SURE...IF IT'S

Westinghouse

How Claude Phillips helped

More than ten years experience as a welding specialist gave Claude Phillips a sound basic knowledge of metallurgy and grinding methods. In the years since World War II, he has expanded that knowledge into an expert's familiarity with all types of grinding techniques. It is this wide yet concentrated experience that makes him so outstandingly useful to his customers.

cut stainless steel weld-grinding costs

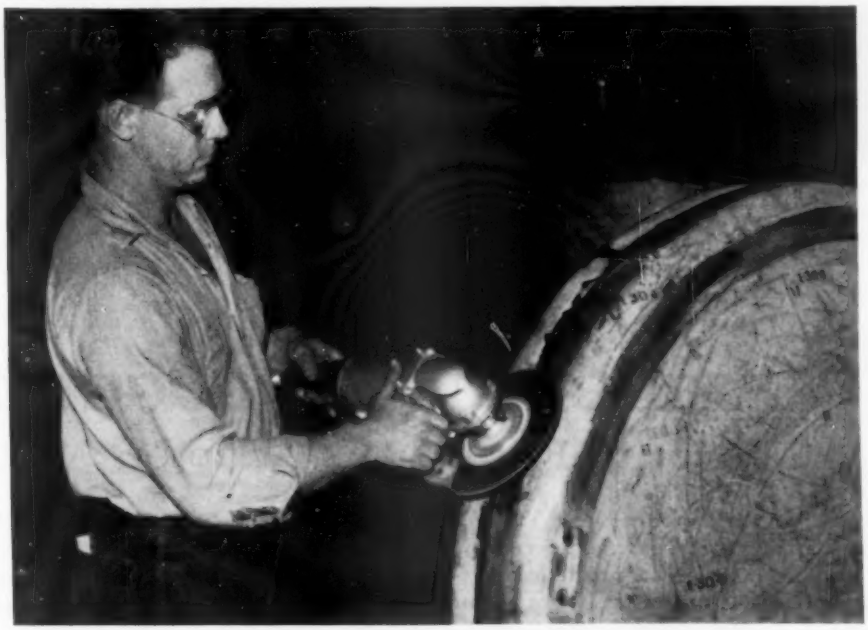
There's nothing delicate about stainless steel until you overheat it. Then you've got a problem... because excessive heat breaks down the chemical structure of the metal and reduces its resistance to corrosion.

Nobody is more conscious of this than Plant Manager John Luker of Gaston County Dyeing Machine Co., Stanley, N. C., and the man who helped him solve the problem... Claude Phillips of Bay State distributor Southern Oxygen Company.

Knowing the job that Bay State Blue Flash R grade wheels had been doing for others, Phillips persuaded Luker and Purchasing Agent James Stroup to try them. They not only cut cool... comfortably below the 670°F critical limit of stainless... they gave him a higher rate of stock removal than any other wheel on the market. As a result, more work is produced per payroll dollar and there are neither hot spots nor weak spots in Gaston County Dyeing machines.

Like Claude Phillips, your own Bay State distributor is an experienced specialist in grinding problems. Cost-cutting ideas he develops for others may be unexpectedly useful to you, too. Why not get in touch with him and see what he can do? *Better grinding at lower cost—that is his business.*

Operator uses 9" x 1/8" Blue Flash R grade raised hub disc wheel to blend pressure tank of T-316 stainless. This wheel generates minimum heat yet gives extremely high rate of stock removal.



BAY STATE WHEELS of PROGRESS

BAY STATE ABRASIVES

Bay State Abrasive Products Co., Westboro, Massachusetts.
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FLEXIBLE MASK GOGGLE
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Larger face mask for greater protected area . . . deeper cup for increased lateral protection and easy fit over all safety R glasses and personal glasses . . . modified nosepiece for greater comfort — these are highlights of this new goggle for welders. Lens adapter is black, flame-resistant nylon — accommodates our standard lens ring and regular 50 mm. round filter lenses and cover lenses. Rings and lens adapter are quickly removable and replaceable. Frame is soft, face-hugging vinylite. Indirect ventilation ports prevent fogging.

RECOMMENDED FOR
acetylene welding, cutting, burning, brazing and furnace work against harmful light rays, glare, flying sparks and scale. Goggle is fitted with Noviweld filter lenses, shades 3, 4, 5, 6. Your nearest AO Safety Products Representative can supply you.

Always insist on the AO Trademark on lenses and frames

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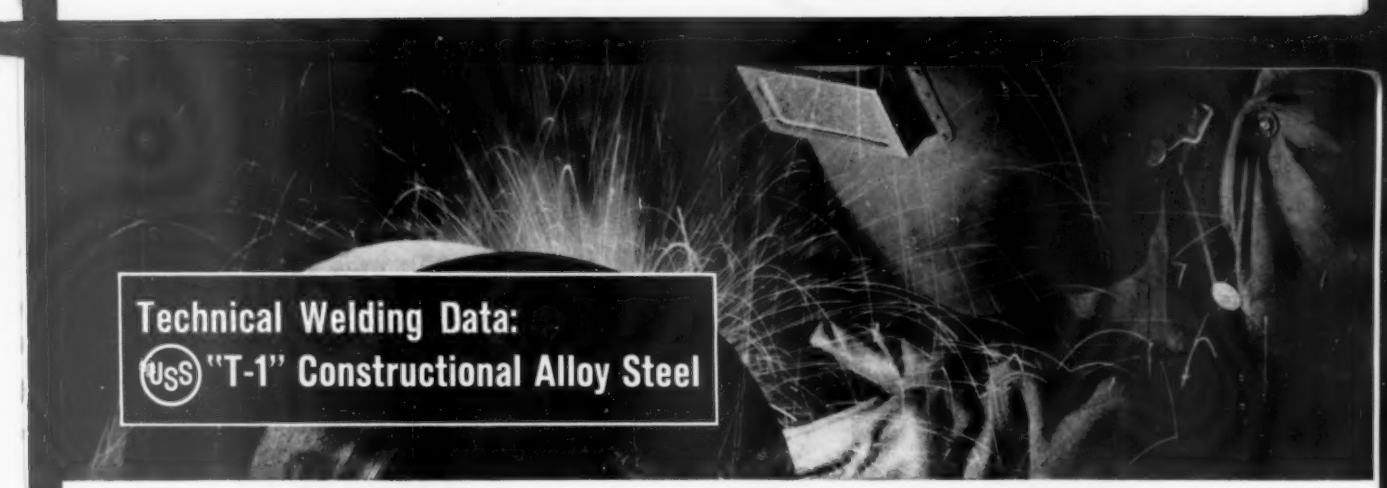


Technical Welding Data:
USS "T-1" Constructional Alloy Steel

4. Weld Metal Properties

As an aid to the engineer and designer, here are the properties of weld metal deposited by a few types of available electrodes. Other very good types of electrodes are now on the market.

TYPICAL CHEMICAL COMPOSITION AND MECHANICAL PROPERTIES OF WELD METALS DEPOSITED BY HIGH STRENGTH ELECTRODES

AWS Class	Comp. Type	Weld-metal composition, % (undiluted deposit)										
		C	Mn	P	S	Si	Ni	Cr	Mo	V	Cu	Ti
E9015	Mn-Mo	0.07	1.45	0.025	0.024	0.39	0.06	0.08	0.35	0.02	0.14	0.013
E11016	Mn-Ni-Mo	0.08	1.02	0.015	0.030	0.28	3.73	0.01	0.63	0.005	0.11	0.014
E12015	Ni-Mo-V	0.06	1.12	0.011	0.018	0.40	2.11	0.11	0.95	0.21	0.11	0.005

AWS Class	Comp. Type	Condition	All-weld-metal tensile properties (0.505″ diam. specimen)				
			Interpass Temp., °F.	Yield Strength (0.2% Offset), psi	Tensile Strength, psi	Elong. in 2 in., %	Red. of area, %
E9015	Mn-Mo	As-welded	100	88,800	95,700	16.3	28.1
E9015	Mn-Mo	As-welded	Rising	61,750	84,600	29.0	62.5
E9015	Mn-Mo	Stress-relieved (1100°F.)	100	87,250	94,200	23.5	55.7
E9015	Mn-Mo	Stress-relieved (1100°F.)	Rising	67,500	82,500	26.8	63.1
E11016	Mn-Ni-Mo	As-welded	100	119,300	124,400	18.5	54.5
E11016	Mn-Ni-Mo	Stress-relieved (1100°F.)	100	106,200	113,400	21.2	58.6
E12015	Ni-Mo-V	As-welded	100	113,300	129,200	20.5	58.7
E12015	Ni-Mo-V	Stress-relieved (1100°F.)	100	116,000	128,700	18.8	59.4

AWS Class	Charpy-keyhole impact properties		
	Comp. Type	Condition	Ductility-transition Temp., °F.
E9015	Mn-Mo	As-welded	minus 155
E9015	Mn-Mo	Stress-relieved (1100°F.)	minus 83
E11016	Mn-Ni-Mo	As-welded	minus 166
E11016	Mn-Ni-Mo	Stress-relieved (1100°F.)	minus 90
E12015	Ni-Mo-V	As-welded	minus 78
E12015	Ni-Mo-V	Stress-relieved (1100°F.)	above 130
E12015	Ni-Mo-V	Quenched from 1675°F., tempered at 1175°F.	45 above zero

NOTE: Weld metals deposited by such electrodes on USS "T-1" Steel would have their chemical compositions altered by admixing of elements from the steel, and their yield and ultimate strengths would be increased.

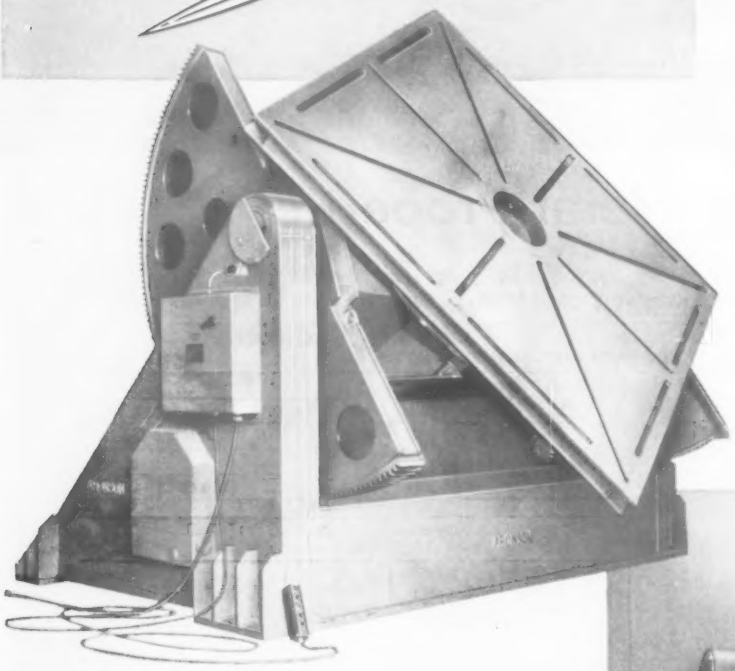
REMEMBER THIS: No other alloy steel offers the combination of properties that "T-1" Steel possesses. Here, in just one steel, you get very high yield strength (100,000 psi minimum), extraordinary toughness, great resistance to impact abrasion, and good high temperature strength. These let you reduce the size of highly stressed parts . . . save weight, reduce the amount of welding required and cut your costs. USS "T-1" Steel is being used in bridges, excavating equipment, pressure vessels, towers . . . in equipment that must take heavy abuse in sub-freezing temperatures . . . in equipment that must withstand heavy stresses and impact abrasion at temperatures up to 900°F.

WRITE FOR COMPLETE INFORMATION about the application and fabrication of USS "T-1" Steel. United States Steel, Room 2801, 525 William Penn Place, Pittsburgh 30, Pennsylvania. *USS and "T-1" are registered trademarks*

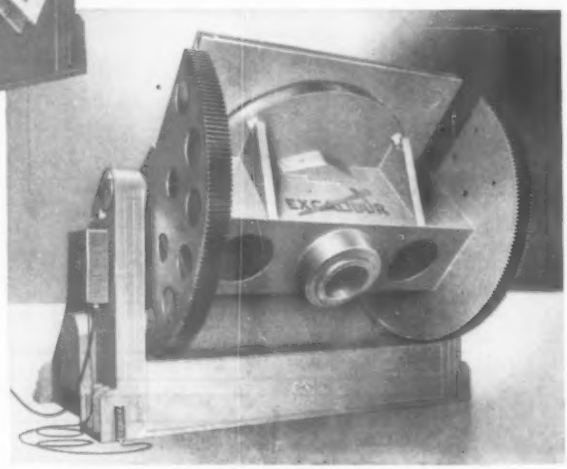
United States Steel Corporation—Pittsburgh
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Supply—Steel Service Centers
United States Steel Export Company

USS United States Steel

EXCALIBUR..... the HIGHEST LOAD CAPACITY Welding Positioner EVER BUILT



Aronson
MODEL G 3500



"EXCALIBUR" is rated 350,000 pounds Load Capacity with CG 12" above table and 6" off-center.

FOUR SELECTIVE VARIABLE SPEED RANGES obtained from the 4-speed gearshift transmission driven by 15 hp Varidrive afford far greater choice of variable rotation speeds. In High Gear top speed is .4 rpm adjustable to .07 rpm. This exceptionally high rotation speed permits automatic welding at high travel rate on diameters as small as eight inches! Then, for larger diameters shift into 3rd Gear and use the .23 rpm to .04 rpm range. Or, still larger work may require 2nd Gear's .13 rpm to .023 rpm range. Largest weldments are profitably rotated in Low Gear range's .08 rpm to .013 rpm.

"EXCALIBUR" is not physically tremendous, being only 88" from floor to horizontal rotation axis, which allows working both large and small weldments without needing excessive headroom and without working too high above the floor.

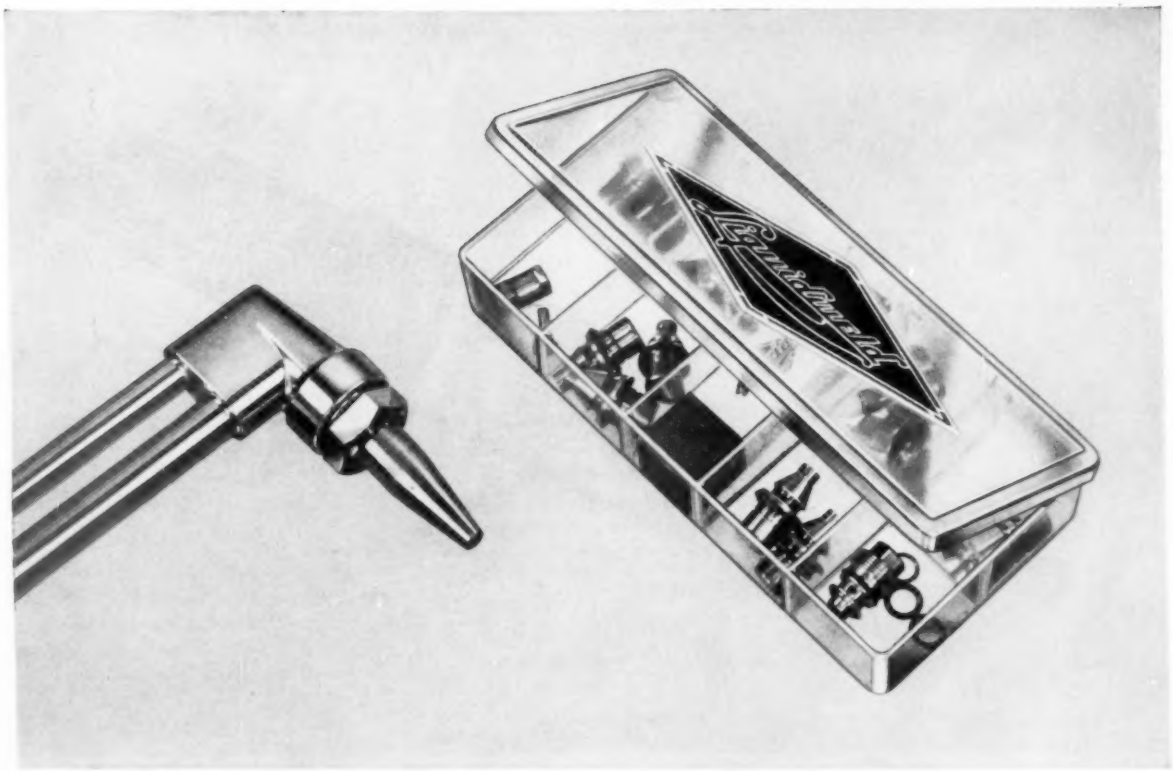
"EXCALIBUR" has been designed to handle almost every kind of weldment at lowest possible shop cost.

Owning "EXCALIBUR" opens production doors to you that are closed to your competitors. It is NOT a special job machine, but a Welding Positioner that will handle 90% of your jobs that are as small as a ton or so to as large as 175 tons!

Owning **"EXCALIBUR"** lets you weld automatically those jobs you now wrestle around the shop floor with the profit-eating crane and have to weld manually.

With **"EXCALIBUR"** in your list of machine tool facilities you not only can underbid competition but can assure the award of the contract because your customer will know you have the facility to handle his work.

Quality POSITIONERS by **Aronson MACHINE COMPANY**
ARCADE, NEW YORK



LIQUIDWELD TORCHES

provide **"Do-It-Yourself" repairability** on the job

Down-time is reduced and operating delays cut to a minimum when you use Liquidweld.

Because of Liquidweld's unique design (with a replaceable mixer sleeve), reseating of cutting torch heads is eliminated. Most parts can be installed *on* the job, *by* the Liquidweld operator!

"Do-It-Yourself" kits of replacement assemblies are now available for both Liquidweld welding and cutting torches.

LIQUID CARBONIC
DIVISION OF GENERAL DYNAMICS CORPORATION
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Please send me details on Liquidweld torches and "Do-It-Yourself" kits.

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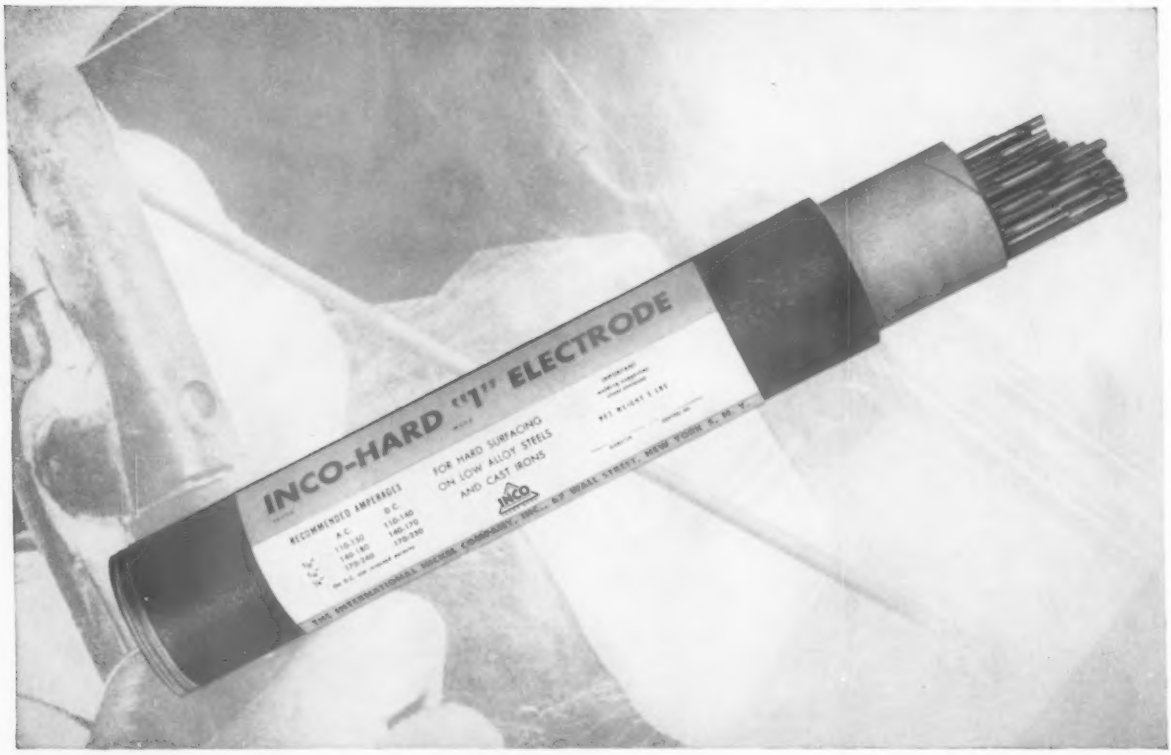

NEW INCO-HARD "1" ELECTRODE

for hard surfacing on low alloy steels and cast irons

Extremely Hard

- *One-layer deposit gives you Brinell hardness of 500*
- *Two-layer deposit from 650 to 700 Brinell*

Easy to use

- *Can be used in all positions*
- *Stable spray-type arc*
- *Excellent wash*
- *AC or DC*
- *Smooth bead contour*

Recommended amperages for Inco-Hard "1" Electrode

	AC	DC
5/32" size	110-150	110-140
3/16" size	140-180	140-170
1/4" size	170-240	170-230

On DC use reverse polarity

Use Inco-Hard "1"* Electrode for: overlaying baffle plates, caterpillar heads, dipper bucket teeth, scraper lips . . . wherever parts need resistance to severe abrasion.

Complete data and suggested procedures on using Inco-Hard "1" Electrode are given in a new 8-page data sheet. For your copy, write:

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

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INCO WELDING PRODUCTS
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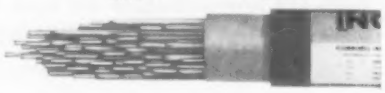


BETWEEN PASSES

booming business

Since WELDING ENGINEER reported on explosive forming in the August *WeldWorld*, the technique has literally been booming. Over a score of firms are either engaged in research or are actually using the method in production. Controlled explosions as a means of forming complex shapes have produced some startling results: 70% elongation in metal normally elongating only 42%; one metal sheet split into two, with each section being dimensionally accurate within 0.002-in.; metals fracturing at their strongest point and perpendicularly to stress. One not-so-startling result: most fabricators found welds stand up under explosive force.

off the list

In August, this magazine's *WeldWorld* department revealed Inco of Canada was slashing nickel production by 20%. Main reasons, we stated, were big inventories and large U. S. government stockpiles. *Confirmation:* a recent Defense Department directive dropped nickel from the "Conservation List." Also freed from restrictions were abaca, asbestos, cadmium, diamonds (industrial and bort), mica, silk and sisal.

Platanode

Being amused by the eccentric names which are given ships and boats is one of the minor diversions of this editor. And one of the most novel names to cross our desk recently is that of a small pleasure boat christened "Platanode." "Platanode," we learned is a portmanteau word derived from "platinum" and "anode." It was used by International Nickel Co. and Charles Engelhard, Inc. to publicize a means of combating sea corrosion. Principle is to use a platinum anode to electrically neutralize the harmful effects of salt water on metal hulls. Now in use on such ships as the aircraft carrier, *Independence*, the A-sub, *Triton*, and other large Navy and Merchant craft, "Platanode" marks the first attempt to apply the principle to small boats.

Smith featured

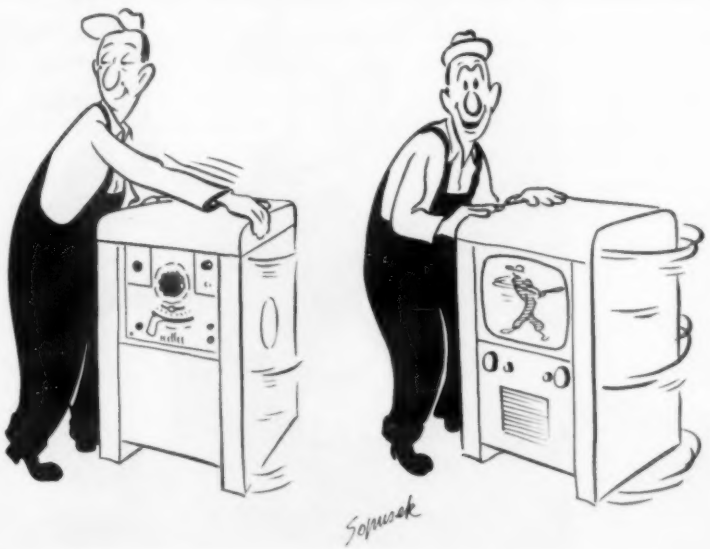
Smith Welding Equipment Corp., Minneapolis, recently was featured in the lead article in the *Brass and Bronze Forgings Digest*, a publication of the Copper & Brass Research Association. Reason for the honor is Smith's extensive use of brass forgings in its gas regulators.

lines on the Line

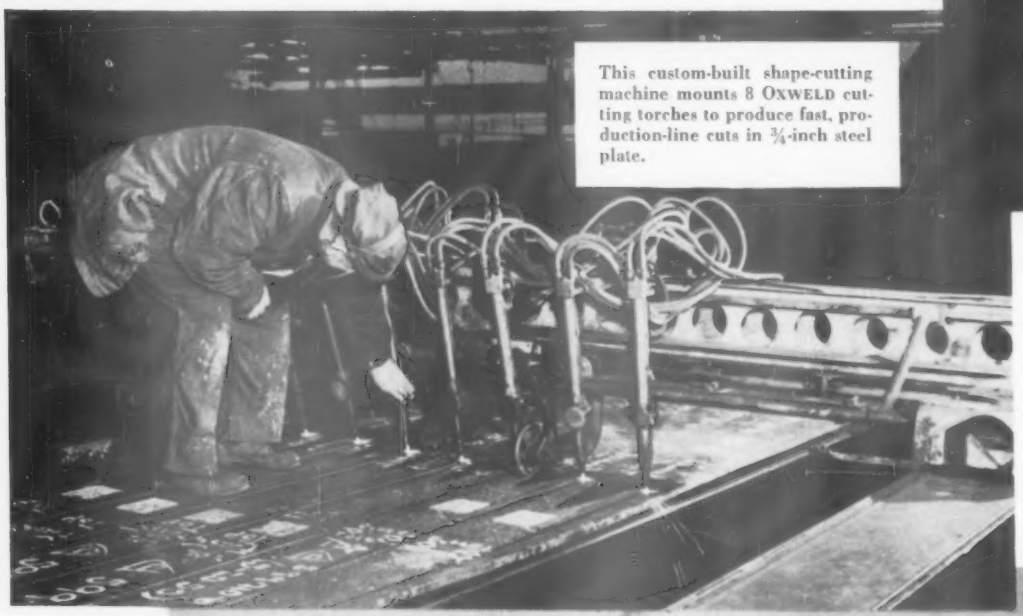
". . . nor do I think a magazine . . . will be welcome if it talks over the heads of those for whom it is intended. I am going to use plain words and common sense." Thus, in words and sentiments with which WELDING ENGINEER heartily agrees, began the first issue of *The Houghton Line* back in 1908. Now celebrating its 50th anniversary, the *Line* has proved this philosophy can bring a magazine more than its share of success. Its editor, Board Chairman A. E. Carpenter, prefers to be called a Near Editor (a title he inherited from his father, C. E. Carpenter, who felt he was a businessman first and an editor second). The *Line* mixes cracker-barrel comment, fishing hints, humor and feature material with its advertisements for E. F. Houghton & Co. How well this editorial position—or should we say near-editorial position?—has succeeded can be gaged by the fact that 200,000 readers keep coming back for more.

for art's sake

Sculptors, if you'll excuse an inexcusable pun, are showing their mettle. And that's not just our opinion, either. The art editor of the Associated Press recently wrote: "The old-fashioned sculptor used to wield hammer and chisel on wood and marble. That has changed. He works in a shop rather than a studio. He welds and forges. . . . His materials are aluminum, steel, copper and wire." To prove this thesis, a number of photographs were included with the article, mostly of welded sculpture. Most interesting among them was a picture of a piece called "The Sun" by Richard Lippold. The artist devoted three years to creating and welding the nearly two miles of gold wire that make up his impression of the sun and its rays.

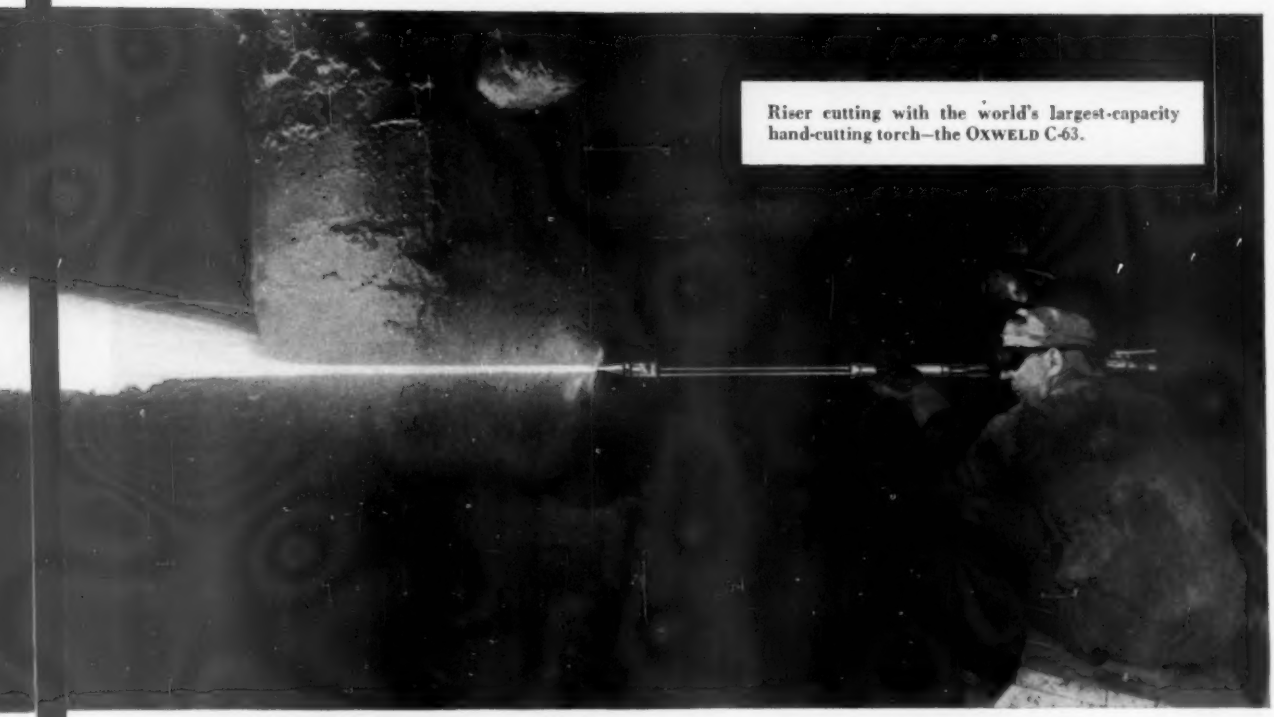


NOW Oxweld TRADE-MARK CUTTING TORCHES...



This custom-built shape-cutting machine mounts 8 OXWELD cutting torches to produce fast, production-line cuts in ¾-inch steel plate.

A full selection of precision-made OXWELD nozzles assures maximum usefulness for every cutting torch.



Riser cutting with the world's largest-capacity hand-cutting torch—the OXWELD C-63.

...for every fuel gas combination

★ OXY-ACETYLENE ★ OXY-PROPANE ★ OXY-NATURAL GAS

Hand-cutting, shape-cutting, scarfing, powder-cutting . . . you name the cutting job! And pick the fuel gas combination, too . . . oxy-acetylene, oxy-propane, oxy-natural gas. Whatever your flame-cutting requirements, there's a complete line of dependable OXWELD torches to meet them exactly.

You can choose from the widest selection of top quality torches and nozzles ever made available—a choice that assures you of genuine OXWELD performance on every cutting job. Backed by half a century of know-how, OXWELD cutting torches and OXWELD nozzles are designed and built to give you trouble-free service, one hot job after another, year in year out.

Ask your nearby LINDE representative to *prove* OXWELD performance to you today. He'll be glad to study your flame-cutting program and demonstrate how OXWELD cutting torches can help you save. Also write for free booklet, F-1174. LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. *In Canada:* Linde Company, Division of Union Carbide Canada Limited, Toronto.

Look to LINDE . . . for the Best in Welding and Cutting Apparatus

Linde TRADE-MARK

UNION CARBIDE

"Linde," "Oxweld," and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

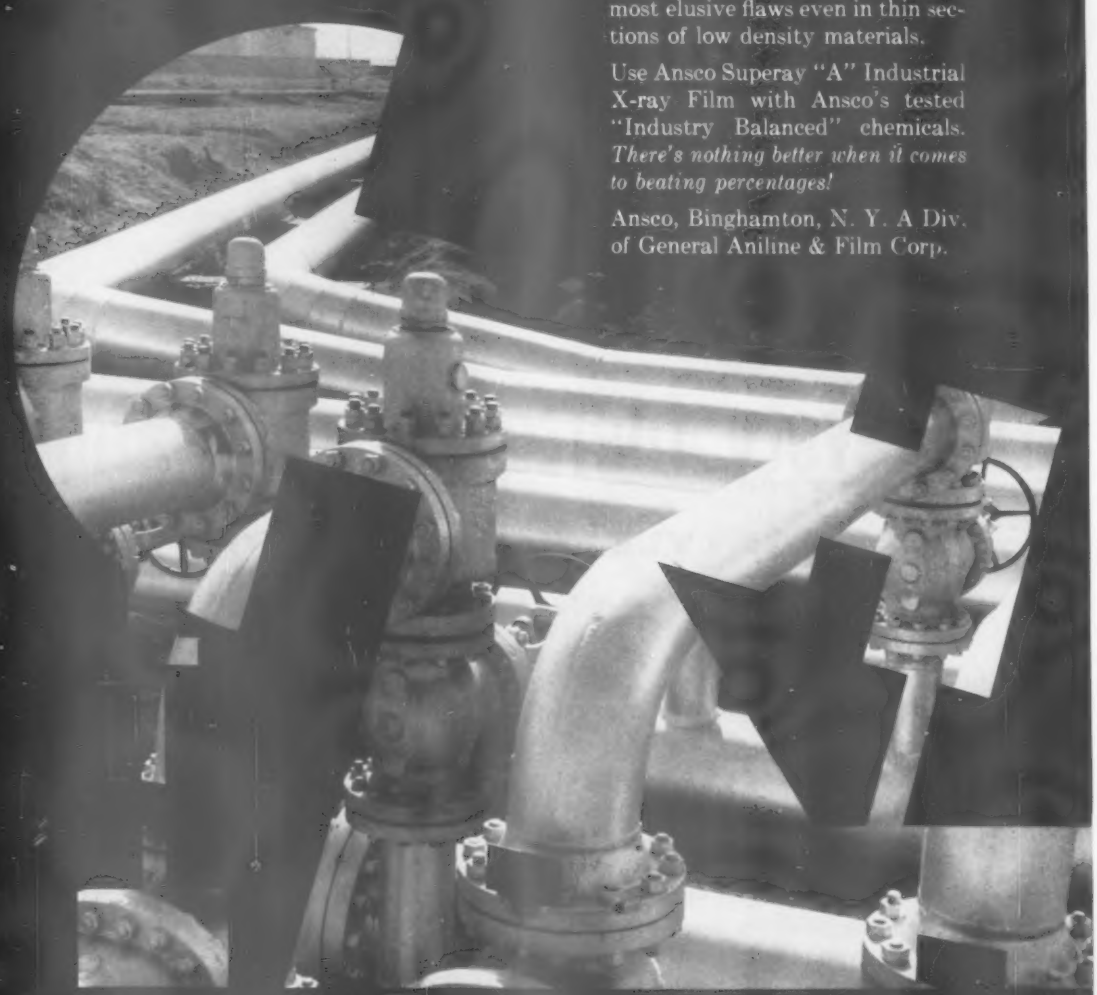
How Ansco helps you beat the weld-break percentages

As long as welds are subjected to the element of human error, a certain percentage will have flaws. That's where Ansco comes in. Ansco's superb Superay "A" X-ray film holds the percentage of undetected imperfections down to a minimum.

That's because Ansco Superay "A" offers characteristics of high speed and fine grain permitting high contrast techniques that detect the most elusive flaws even in thin sections of low density materials.

Use Ansco Superay "A" Industrial X-ray Film with Ansco's tested "Industry Balanced" chemicals. *There's nothing better when it comes to beating percentages!*

Ansco, Binghamton, N. Y. A Div. of General Aniline & Film Corp.



Ansco

Industrial X-ray

This message is for men who are vitally concerned with such welding problems as maintaining a smooth flow of production... preventing excessive rejects... and insuring trouble-free, economical, profitable operation

Welding Wire: Cost-saving and Profit Factors

Production men who are conscious of *both cost and quality* agree that a top-grade weld demands the *right* welding wire. *Only* by using wire with an analysis suited to the material to be welded can consistently sound welds—free from porosity and internal cracks—be produced. Use of the right wire means fewer rejects, less waste, lower costs—plus a better finished part or product.

Experienced welding men have long found PAGE a most reliable source of welding wire for all their regular and special needs. The wide range of PAGE analyses—33 of them—makes it possible to select the exact wire that produces the kind of welds that lower production costs and increase profits.

PAGE experience, talents and facilities are available to you at all times. We have been exclusive wiremaking specialists for more than half a century, and are in an ideal position to furnish our customers with the right wire for each specific need. Furthermore, we have developed a broad packaging program which saves time and money by supplying wire packaged to meet any requirement.

These factors, plus PAGE'S nationwide set-up of conveniently-located distributors, backed up by PAGE warehouse stocks, help make it profitable for you to standardize on PAGE Welding Wire.

Write for—Welding Wire **Comparison Chart DH-1218** (shown above). This highly informative, four-page chart lists detailed analyses of PAGE automatic welding wires, metal spray wires, bare electrodes and gas welding rods. Also shows uses and physical properties, including: tensile strength, elongation, Rockwell hardness. Chart lists virtually all competitive makes.

NOTE • *Look to PAGE, not only for automatic welding wire, but for gas welding rods, bare electrodes, metal spray wire*

• • •

Write for—Submerged arc and inert gas welding wire **Folder DH-402A**...also gas welding rod **Booklet DH-1277.**

drum...ready to be smoothly unreeled to the welding head for automatic or semi-automatic welding! Eliminates costly machine down-time for coil replacement. Payoffpaks come in three sizes: 20" diameter (holds 250 or 500 lbs.); 23" diameter (holds up to 700 lbs.).

• • •

Write for—**PAGE Welding Wire Packaging Chart.** • This useful chart shows the many kinds of packaging of PAGE Welding Wires for each type of welding.

PAGE offers—
33 ANALYSES
...the right analysis for your welding job

There are *33 different analyses* in the PAGE line, covering the broadest range of applications: submerged arc...inert gas...tungsten or metal arc...oxy-acetylene gas welding...metal spraying.

For example—

ANALYSIS A-S-65...This reasonably priced hard facing material, with inert gas, a neutral flux, or oxy-acetylene flame, deposits a machinable overlay (from Rockwell B-95 to B-99) which hardens under impact to Rockwell C-10, and resists abrasion and erosion. A-S-65 is also used for build-up where a final layer of hard facing material is to be used.

For example—

ANALYSIS A-S-ARMCO IRON...Famed for purity and dependability, Armco Iron contains less than .10% total quantity of other elements. Armco Iron Filler Metal—exclusive with PAGE—is favored by high-quality producers for very limited analysis ranges, where alloying elements are to be added, either through a flux or a coating.

NOTE: previous advertisements in this publication have included brief descriptions of PAGE Analyses A-S-8620, A-S-6150, A-S-30 and A-S-NAX-9115. Detailed information on all 33 PAGE analyses is contained in our Welding Wire **Comparison Chart DH-1218.**

PAGE offers—
Packaging to meet your needs

PAGE Welding Wires are packaged in a wide variety of ways—for the most complete protection and the utmost convenience in handling, in stocking and in use. Here are some major types of PAGE packaging:

1. **Paper-wrapped Coils**
2. **Coils in Cartons, Palletized**
3. **Bare Coils (packed in Leverpaks)**
4. **Masonite Reels**
5. **Payoffpaks**
6. **Payoffpallets**
7. **Gas Rods in Burlap-wrapped Bundles**
8. **Stainless Gas Rods in 10-lb. Tubes**

For example—

PAYOFFPAKS...Up to 700 lbs. of wire, without a single weld...coiled around a fiberboard cylinder within a fiberboard

PAGE offers—
Availability from local stocks

Here is a handy service that not only gets you the welding wire you need when you need it, but saves you money by making it unnecessary for you to tie up a sizeable investment in wire inventory.

You can get the exact PAGE automatic welding wire and welding rods your job requires direct from your nearby PAGE Distributor. Located at many points from coast to coast, PAGE distributors carry sizeable stocks for your convenience—and they are backed up by PAGE Warehouses at the strategic locations shown below. Close cooperation between PAGE distributors, PAGE warehouses and the PAGE mill is your guarantee of prompt, intelligent, individual service on your specific needs.

ACCO

Page Steel and Wire Division
AMERICAN CHAIN & CABLE

Monessen, Pa.*, Atlanta, Chicago*, Denver*, Detroit, Houston*
Los Angeles*, New York, Philadelphia*, Portland, Ore.
San Francisco*, Bridgeport, Conn.
**Indicates PAGE warehouse stocks*

ACCO for Better Values

Weldynamics

ARC WELDING AT WORK CUTTING COSTS

I found that with Jetweld LH-70 electrodes, no matter what you weld, you can be sure of the job.

Andrew Wantuck
Capreol, Ontario

I welded 4000 feet of 4" pipe with Fleetweld 5-P. I found it the perfect rod for stringer, hotpass, fill and cover pass. Also, I had the cleanest nick break that I ever had in a test using Fleetweld 5-P.

Ted Lee Regan
La Crescenta, California

I just renewed my Navy arc welding certificate with Fleetweld 7 and I passed with flying colors. Most of this work is secret, but it's no secret that Lincoln products are doing their part in this field.

Golin E. Noel
Redondo Beach, California

Your weldor's opinion is worth a thousand words

For data and specifications on Lincoln's complete line of mild steel electrodes write us and request Bulletin 7000.1.

The World's Largest Manufacturer of Arc Welding Equipment

© 1958 The Lincoln Electric Company

THE LINCOLN ELECTRIC COMPANY, DEPT. 1746, CLEVELAND 17, OHIO

OCTOBER, 1958

Welding Engineer

ESTABLISHED 1916

If it's well done, say so!

WHY IS A PAT ON THE BACK so hard to come by? What has happened to industry's oldest and most reliable employee relations gesture?

We know executives who will gladly give hundreds of dollars to charity, but they will almost never give an employee a kind word. To be perfectly fair to these men, we will point out that *(1)* a desire to help others prompts virtually all of their charitable donations, and that *(2)* they value the employee and desire his friendship.

So why the disparity in acts of individual kindness?

We can't provide a ready answer to that question. Maybe the pat on the back is simply forgotten as the executive becomes increasingly preoccupied with business problems. Maybe the incentive-killing taxation of our age has filled executive minds with thoughts that simply don't lead to kind words.

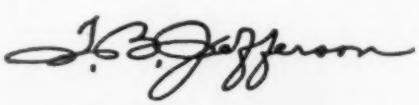
But any answer we may provide to this question is actually no answer at all. There has never been a valid reason for forgetfulness!

Examine your feeling right now for the weldor in your shop. Do you ever notice him? Not many people do, you know, until things go wrong with a welding job. Then the weldor becomes a pretty important guy—a fall guy, to be exact. And even if the difficulty isn't his fault, he's a good man on whom to fix the blame.

He takes the blame for mistakes—so why shouldn't he also receive some credit when things go right? You may even remember occasions when his good work pulled your neck out of a noose and saved *you* from being a fall guy.

Most of the weldors in any shop have their company's interests at heart. And it's up to every executive to see that the paycheck isn't the only reward for loyalty, honesty and hard work. Wages are certainly vital, but there are few men who can maintain their morale on the basis of money alone. As a matter of fact, there are probably many workers who have felt at times that they would be willing to trade some part of a paycheck for just one word of approval from The Boss.

If the fellows in your shop are doing a good job, show your appreciation. A meaningful pat on the back and an earnest "thank you" can do a lot for two people: one is the weldor who knows his efforts are recognized; the other is *you*.



This roller, hardfaced with Victoralloy, shows practically no wear after crushing 40 tons of rock hourly, 8 hours daily for 30 days.

HOW TO SAVE ON ROLLERS AND ROD

....*Use VICTOR Hardfacing*

• FREE •
Victor Hardfacing Manual shows you right rod to use and how to apply it.
Write us NOW for your copy.

Profitable dealerships open; inquire now!

Tracy Rock & Gravel Co., Tracy, Calif., crushes 40 tons of rock hourly, prolongs roller life on this rough work by rebuilding with ¼" VICTORALLOY #1 Bare Electric rod, 28" length. Says plant superintendent Albert Parker:

> "Victoralloy's ease of application and fast buildup mean a lot to us. There is no lost time as we use 28" length rod; when it burns down, we touch a new rod to the old one, and keep on welding without even lifting the helmet."

You, too, can save rod and increase working life of crusher rolls, screens, shovel teeth, tractor rollers and idlers, dredge pumps and many other parts subjected to abrasion and severe impact. Simply hardface with VICTORALLOY. It welds to manganese, steel or cast iron. You get all position hardfacing, exceptional arc stability, deposits free of porosity, fast application without slag interference. Try it. Order a supply from your VICTOR dealer TODAY.

37 VICTOR for hardfacing

VICTOR EQUIPMENT COMPANY

ALLOY ROD AND METAL DIVISION

13808 E. Imperial Highway, Norwalk, Calif. • Wakita, Oklahoma

Welding Engineer

The shed-like railcar maintenance shop is a thing of the past for Union Tank Car Co., proud owner of this remarkable steel dome which will now house railcars undergoing repairs. Welding details and fabrication facts are given on pages 42 and 43.

Our present age of mechanization is also—among other things—an age of communications. Nowhere is this more obvious than in the field of business publications. Whatever your occupation, chances are you'll find a magazine devoted to your interests.

Though it is a specialized field, welding takes many forms. Its application demands a knowledge of metallurgy, economics, physics, mechanical drawing and many other scientific and practical subjects. The business publication which sets itself the task of informing the welding engineer and welding supervisor, therefore, must be ready, willing and able to cover its field accurately and extensively.

It must stand ready to report, for example, the facts and figures on resistance welding equipment and controls . . . on storage tank fabrication . . . on building construction. It must even report on nuclear power and the role welding plays in its development.

In short, it must do what *Welding Engineer* has done in this issue—and will continue to do 12 times every year.

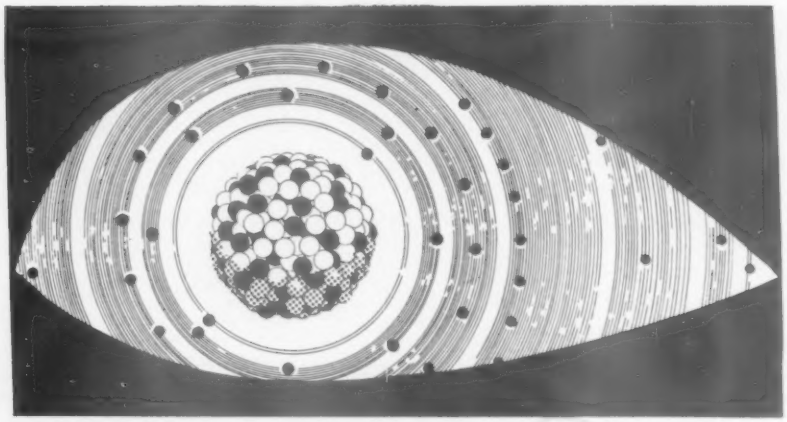


FIG. 1: Artist's "eye" view of the strange world of the uranium atom. The center nucleus of protons and neutrons is encircled by groups of electrons—beginning with two in the shell nearest the nucleus, and out to the final shell.

Part 1—Principles

A guide to nuclear power

By W. D. Briggs
Murex Welding Processes Ltd.

Since welding plays such an important role in today's atomic age and will have an even more important part in the atomic future, the editors of WELDING ENGINEER feel the why's and wherefore's of atomic power might prove interesting reading. Our thanks to *The Welder*, Waltham Cross, Herts, England, for permission to reprint the series.

DEVELOPMENT of the metallurgical microscope brought about a tremendous advance in the science of metallurgy, and for many years it was believed that examination of grain structure represented the ultimate in understanding the behavior of metals subjected to stress, heat treatment, etc.

It was later realized, however, that each individual grain of metal visible under the lens of a powerful microscope only represented, as it were, the complete walls which determine shape and size of a building.

Apart from certain general features, represented in the building analogy by doors and windows, it is still impossible with a metallurgical microscope to see constructional details, i.e. to see in which way individual bricks are arranged to give the whole unit its strength and solidity.

Development of X-ray examination techniques later made possible the discovery that each grain was composed of rows of atoms arranged in a regular pattern, the type of pattern largely determining the material properties.

But to go one step further—to decide that the bricks are really bricks and not blocks of painted granite—is more difficult, and it is necessary to subject the material to several tests. With various metals there is no direct way of looking at the atoms—but careful experiments have shown that a great deal can be learned about the inner structure.

The atom consists mostly of empty space—in the center is a nucleus and spinning around it are a number of satellite electrons. These elementary particles can be weighed; the heavy nucleus carries a positive charge, while each spinning electron carries a negative charge and is very light.

Electrical charges balance, meaning the simple atom is electrically neutral, possesses a definite weight (largely concentrated in the nucleus), and a size (determined by the average distance between nucleus and electron).

The simplest atom, hydrogen, consists of a nucleus carrying one positive charge and a single orbital electron carrying one negative charge. The nucleus of helium gas atoms carries two positive charges—considerably heavier than hydrogen—and has two electrons in orbit.

Lithium metal starts a new sequence—one positive charge is added to the helium nucleus, but the extra electron which goes with it starts orbiting on a new outer sphere or shell. And so the series continues, the second electron shell is filled when there are eight electrons spinning, and the third starts with metal sodium.

The largest number of electrons found in a naturally occurring metal is 92. The nucleus of the uranium atom carries 92 positive charges with 92 electrons arranged in a series of spheres-within-spheres containing 2, 8, 18, 32, 21, 9 and 2 electrons as shown in figure 1.

Because an atom consists of these various particles all moving at high speeds and carrying electric charges, it possesses a certain amount of energy.

When two or more atoms are combined to form a molecule, it often happens that the sum of the energies of the two atoms is greater than the energy of the new molecule—there is, in fact, a surplus of energy after combination has occurred as illustrated in figure 4.

When this happens, the extra energy is dissipated in the form of heat. Familiar examples of this occur in the burning of oil or coal and in thermit welding. But in a reaction of this type the atom nucleus does not play a significant part. Energy is derived from a regrouping of the electrons, and the amount of heat evolved is relatively small.

Nucleus structure gives the key to the release of large quantities of energy. The nucleus consists of two particles, the proton, which carries the positive charge, and the neutron, which has the same weight as the proton but no electrical charge.

It is possible then to have three different types of nucleus as shown in figure 5:

(1) A nucleus without any neutrons, e.g. hydrogen.

(2) One in which there are equal numbers of protons and neutrons, e.g. helium, oxygen.

(3) One in which the neutrons and protons are not equal in number, e.g. a form of oxygen known as oxygen^{17} (ordinary oxygen is oxygen^{16}).

Oxygen^{17} is a material much like ordinary oxygen in that it exhibits a similar chemical behavior and has the same charge on the nucleus. But it has a different mass because of the extra neutron and is an example of what is known as an isotope.

Isotopes may be defined as atoms of the same element which have the same number of protons but different number of neutrons. Many familiar elements contain isotopes—iron, for example, consists of 26 protons with four naturally occurring modifications having 28, 30, 31 and 32 neutrons, thus giving the four isotopes of 54, 56, 57 and 58 mass units. (Isotopes are usually written Fe^{54}, Fe^{56}, etc.).

It is possible, however, with the isotopes of certain elements, to regroup the particles which form the nucleus of the atom. If the final product contains less energy than the total energy of the original component atoms, a tremendous surplus heat is evolved.

One such nuclear reaction is illustrated in figure 6. Two atoms of deuterium (a heavy isotope of hydrogen which forms "heavy water") combine to form one atom of helium, and the surplus energy is so great that considerable heat is evolved.

This is the underlying principle of the so called "hydrogen bomb." Such nuclear reactions only occur at very high temperatures—the formation of helium, for instance, occurs continually in the sun.

The element radium was found to be continuously changing by throwing off electrically charged particles. This phenomenon is known as radioactivity, and the particles were identified as:

(1) Alpha rays, which are heavy and positively charged, and could be identified with the helium nucleus.

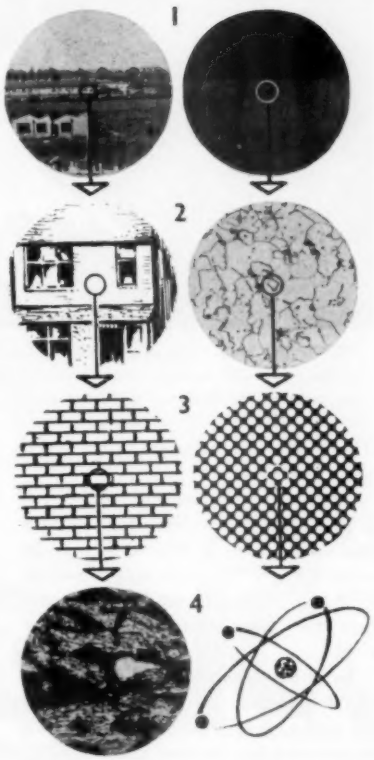


FIG. 2: A simplified analogy to show different forms of structure.

(1) *Left:* Distant view of house. *Right:* Distant view of metal grain (photomacrograph).

(2) Closer view of house and closer view of metal grain (photomicrograph).

(3) Close-up of house wall showing bricks and close-up of metal grain showing atomic lattice.

(4) Microstructure of brick and structure of atom.

FIG. 3: Hydrogen, helium, lithium and sodium atoms in that order. Note increasing number of electrons and shells.

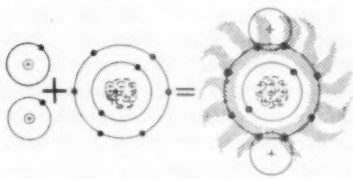


FIG. 4: Two hydrogen atoms combining with one oxygen atom to produce a molecule of water and some surplus energy in the form of heat.

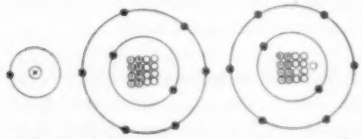


FIG. 5: *Left:* The atom hydrogen with single proton nucleus. *Center:* The atom of oxygen with balanced number of protons and neutrons. *Right:* An isotope of oxygen with extra neutron.

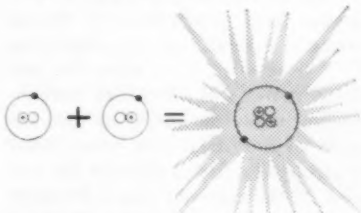


FIG. 6: Two deuterium atoms combining to form helium in nuclear reaction with considerable surplus energy, mostly heat.

(2) Beta rays, which are essentially high-speed electrons.

(3) Gamma rays, which are similar to X-rays and are used for radiographic examination of welds, etc.

Radioactive decay is also found in one of the naturally occurring isotopes of uranium, which possesses 92 protons and 143 neutrons, giving a total mass of 235 units or U^{235}.

If an atom of U^{235} captures a neutron, it can break down into two more or less equal fragments or fission products, while at the same time two or three neutrons are released and a considerable amount of heat is emitted. (See figure 7.)

If one of these newly released neutrons strikes another atom of U^{235}, then further heat and more released neutrons can be obtained—thus producing a chain reaction with a continuous evolution of heat.

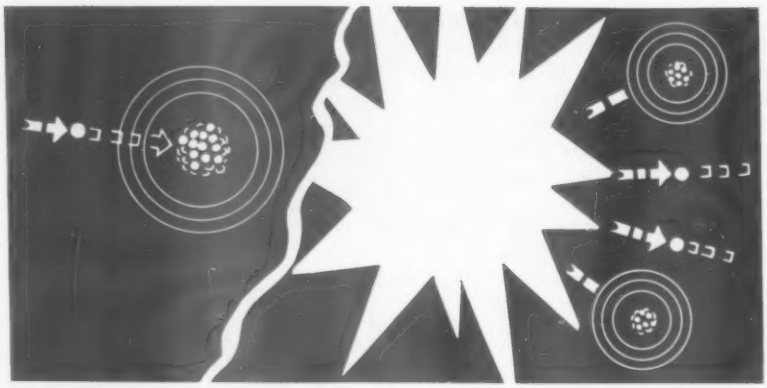


FIG. 7: The breakdown of uranium^{235}. *Left:* A free neutron strikes a U^{235} atom, which breaks down with considerable release of energy to form two fission products and two free neutrons to continue the reaction.

Natural uranium obtained from the ore, however, contains less than 1% of the U^{235} isotope, so that in a block of natural uranium many of the neutrons will be captured by the predominant and non-fissile isotope U^{238}.

One of the first jobs involved in atomic bomb production was the extremely difficult one of separating U^{235} from U^{238}. Even when this was done, it was still difficult to start the fission unless the pieces of uranium were of a critical size, since many neutrons are dissipated from the surface of the material and it becomes impossible to maintain the chain reactor.

Neutrons emitted from the fission reaction possess a high energy and are called "fast" neutrons, whereas the neutron which must be captured by U^{235} to produce the fission reaction should possess low energy. These latter neutrons are called "thermal" neutrons.

Because of the scarcity of U^{235}, it is generally uneconomic for use as a fuel on its own. If diluted, it may be used with U^{238}, but unfortunately, U^{238} has a greater tendency to capture the fast neutrons emitted by U^{235}.

In order to control and sustain the chain reaction, it is necessary for the fast neutrons to be slowed down before striking another atom of U^{235}. This is done by a series of successive collisions with the atoms of a substance which does not capture neutrons readily.

Such a substance is known as a moderator, typical moderators being hydrogen, used in the form of water (H_2O); deuterium, used as heavy water (D_2O); and carbon, used in the form of graphite.

A nuclear reactor using uranium in association with a moderator is called a thermal reactor and consists essentially of a quantity of uranium surrounded by a moderator. The controlled chain reaction is illustrated in figure 8.

Two reactions are taking place in the figure:

(1) Slow neutrons are captured by U^{235}, which is split into fission products, producing heat and two or three fast neutrons.

(2) Some of the fast neutrons are slowed in the moderator to carry on reaction 1. Some are lost or captured by the moderator, while those which retain their energy are captured by the U^{238}.

When this happens, U^{238} is converted to an isotope of another element, plutonium, which may itself be used as a fuel for production of nuclear energy.

A concentrated fuel such as plutonium may be used without a moderator because there is not sufficient absorbing material mixed with the fuel to damp out the chain reaction. Because neutrons are not slowed down in the moderator, these are called fast reactors, and a prototype is being built at Dounreay, Scotland. (*See March issue of* WELDING ENGINEER, *page 34.*)

An important feature of this type of reactor is the operating core can be surrounded with a blanket of relatively inexpensive U^{238} which will be converted by the escaping fast neutrons into more plutonium.

In fact, plutonium will be produced more rapidly than it is being used up in the core, bringing about another type reactor called a "breeder" reactor.

(Part two of this four part series on nuclear power will deal with nuclear reactors. Watch for it in a future issue of WELDING ENGINEER.*)*

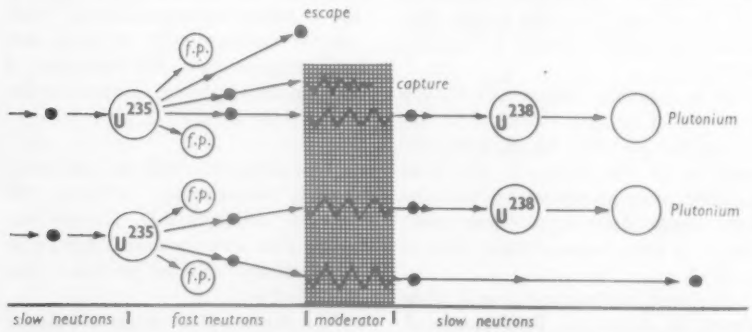


FIG. 8: The use of a moderator to control the type of chain reaction shown in figure 7. This is the basic principle for the thermal reactor.

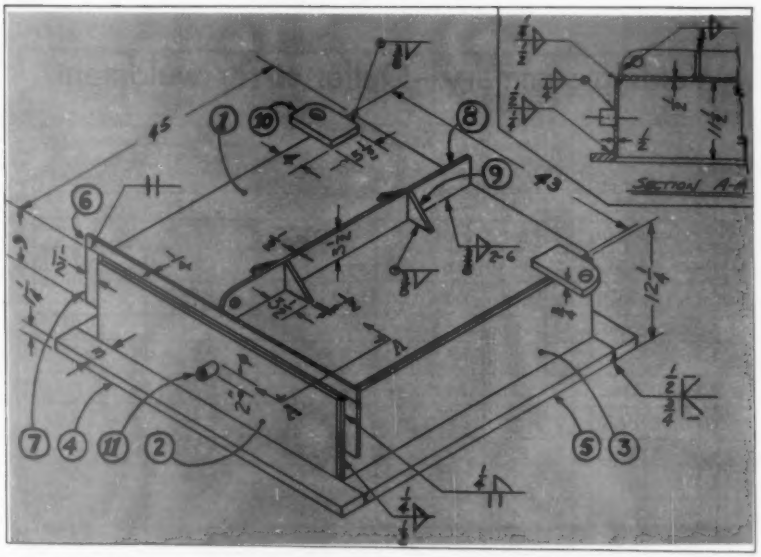
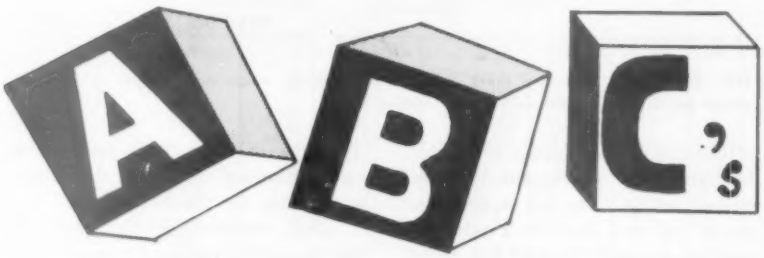


FIG. 1—Outlet cover weldment showing 11 components used in fabrication.



# of weld estimating

by **Clement F. Brown***

ACCURATE FABRICATION estimates are of prime importance to production and job shops alike: good estimates spell profits—too many poor ones will put you out of business.

In producing a weldment, welding time is usually the major operation. This area of work, therefore, merits a study of basic principles plus careful attention to details.

One fact must remain clear: a labor estimate is someone's considered opinion of time and cost required for a specific amount of work. This opinion is influenced by available shop equipment and the estimator's past experience, as well as selection of methods and procedures to do the work.

Considering the personal elements of experience and knowledge, it is easy to see why no two estimates will be in complete accord. In some companies, standard time data (often compiled at great cost) provides the basis for estimating. Such data, however, must be used with discretion when related to another plant's work.

If these facts are kept in mind, the subject of weld estimating can be intelligently considered without misunderstanding.

What is involved in making an accurate weld estimate? A simple outlet cover (Fig. 1) will serve as a good case study to illustrate the points. Several of these 11-piece weldments are used on a large still.

To avoid overlooking any required welding, each individual part comprising the weldment is listed in column one of a summary sheet, (Fig. 2). Part name and amounts are in columns two and three.

Calculated or actual weight of the combined total of individual parts is listed in column four. Total weldment weight proves useful in solving positioning or material handling problems.

The first piece (usually the weldment's major part) is considered only as the starting piece, and no joining welds are required. For the second part, only the amount of welding needed to join it to the first is counted and entered on the summary. The amount should be entered as total footage and weld sizes should be indicated with AWS symbols.

For each additional part, only the amount of welding required to join it to preceding parts is listed, indicating weight per foot of each different weld size. Some unit weld weights are included in the estimating table (Data Sheet No. 217) accompanying this article. They may also be found in several handbooks, or they may be calculated.

Calculation is based on square inches of deposited metal in the weld's cross section, multiplied by 12 in. The product (cubic in./ft) is then multiplied by weight of a cubic inch of weld metal (*e.g.*, a deposited steel electrode weighs 0.238 lb/cu in.) Result is weight per foot.

The figure entered in column five is the result of multiplying weld footage by the weld's weight per foot. Sum of all parts of the outlet cover is shown as total weight of deposited weld metal in column six. Adding this figure to total weight of the parts, the result is the completed weldment's estimated weight.

Deposited weld metal may also be summarized for any given weld size, *e.g.*, scan the listed welds for all ½-in. fillets; multiply total footage by 0.425 lb/ft for a total of 14.5 lb.

This method makes a single step of the later operation of setting time values for specific weld sizes. However, there *is* an advantage in treating each part individually: if later design changes delete any part from the assembly, simply deduct the amount of welding eliminated.

For manual welding, *total weight of deposited weld metal* is converted to *estimated weight of required electrodes* by dividing with a factor of 0.55—a value based on the fact that actual deposited weld metal is 55%

*Author C. F. Brown, M. E., has more than 20 years of experience in tool engineering and welded fabrication. He is presently production and methods engineer for Downingtown Iron Works Inc., Downingtown, Pa.

of the electrode's original weight. The balance is lost in spatter, stub end, or the flux coating.

Up to this point, all elements of the weld summary have been fixed quantities or values. Barring errors of omission or calculation, any estimator considering this case problem should obtain the same answers.

Some elements influencing variations in the labor estimate have already been mentioned. But before making an estimate, consider other important factors affecting deposition rates and welding time.

A—Poor fit-up creates large voids usually unforeseen when the estimate is made. Inspection prior to welding is the only solution. (In most jobbing work, corrective welding time is a direct loss.)

B—Welding in a downhand position requires the least amount of time; overhead welding, the most. Shop experience, as well as handbook information, indicates a 10 to 50% longer welding time for horizontal welding over that done in the flat or downhand position—*but vertical and overhead welding cause a 300 to 400% time increase.* So fixtures and positioners to gain maximum efficiency are obviously important.

C—Filler metals also have a bearing on welding time. For example: a mild-steel electrode is usually deposited in two-thirds the time required for deposition of the same amount of stainless electrode, but it has a slower burn-off rate than iron-powder electrodes.

D—Maximum deposition rates are obtained by using the largest electrode size consistent with good welding. Naturally, adequate root fusion, control of distortion and other factors must be considered.

One rule indicates deposition time for a unit amount of weld metal is proportionate to the square of the electrode's diameter. This means metal is deposited four times as fast with a ¼-in. electrode than with a ⅛-in. size. This observation should not, however, lead to the always expensive practice of over-welding.

E—The welding processes used, and their method of application, influence the time estimate. Although fully-automatic operations are faster, they are often accompanied by increased set-up time and a need for special jigs and fixtures. Production runs are necessary to meet this added expense.

Welding summary—Outlet cover weldment

Part No.	PART NAME	No. Req.	Estimated Weight of Parts	MEASURED JOINING WELDS	Estimated Weight of Deposited Weld Metal	Estimated Time (From tables or calculated)
1	COVER TOP	1	261 lb			
2	COVER END	2	136	7.16 ft ¼ ▷ @.106#/ft; ½ ▷ @.425#/ft	0.76 lb 3.04	19.2 min 65.7
3	COVER SIDE	2	144	11.33 ¼ ▷ ½	1.21 4.83	30.5 104.2
4	END FLANGE	2	104	7.16 ¼ ▷ ½	0.76 3.04	19.2 65.7
5	SIDE FLANGE	2	96	7.5 ¼ ▷ ½		20.0 67.9
				1.0 ½ ▷ @.425#/ft; ¾ ▷ @.957#/ft	0.43 0.96	9.1 18.0
6	TOP BAR	1	5	3.6 1/16 ▷ @.106#/ft	0.38 0.38	10.0 10.0
7	SIDE BAR	2	2	2.0 1.5 1/16 ▷	0.21 0.16	5.3 4.0
8	RIB	1	21	7.5 3/8 ▽ 2-6 (on 2.66' 3/8 ▽ x 1.5 FACTOR)	0.65	25.5
				.25 3/8 ▽ @.239#/ft	0.06	1.5
9	GUSSET	4	4	5.0 3/8 ▽	1.20	29.9
10	LIFT LUG	2	18	3.2 5/8 ▽	0.77	19.4
11	1-1/2" PIPE NIP.	1	2	1.0 1/4 ▽	0.106	2.7
TOTAL WEIGHT.....793 LB					22.94 LB	527.8 MIN
TOTAL WEIGHT-ASSEMBLY.....815.94 LB				ESTIMATED WELDING TIME.....8.8 HR		

FIG. 2—Welding summary sheet listing part number, name and weight as well as estimated deposited weld weight and welding time.

F—Arc time, a highly variable factor, can range from a low of 10% to a high of 75%. (A good average for moderately heavy and large work is 50%.) Weldment design (from an accessibility standpoint), shop working and safety conditions, and equipment can have an important effect also. Even the use of a fair and adequate bonus plan in addition to straight hourly payment will make a remarkable difference in arc time.

With all these points to be considered, it is apparent that time estimating can be approached only on a general basis. Simple rules cannot take the place of knowledge and experience. However, time-saving estimates based on *specific* conditions *can* be developed.

Tables formulated for this case problem were based on *(1)* good fit-up, *(2)* fully positioned work, *(3)* use of mild steel electrodes in *(4)* the largest size consistent with good welding, while *(5)* using manual metal-arc welding, at *(6)* an average arc time of 50%, with positioning, weld cleaning, personal time, etc., accounting for the balance.

These conditions result in an average deposition rate of 2.4 lb per hour for weld sizes up to and including ⅜ in. Above this size, where larger electrodes are used, the rate advances to 3.6 lb per hour, a 50% increase. The higher rate, however, can only be used for the portion of weld over the ⅜-in. size, *i.e.*, the weight of the deposited weld over 0.239 lb/ft.

Estimated time values (taken from tables or calculated) are posted in the last column of the summary sheet and totalled. The result is man-minutes of welding time—readily converted into hours.

Note that intermittent welding for part No. 8 has been changed to an equivalent amount of fillet welding, and the welding time increased 50%. Skip welding, while economical, is delayed by starts and stops and by marking or judging weld locations.

A final word of caution regarding small weldments with short joining welds: table values will be unrealistic, since time for set-up, positioning and other operations will be inadequately covered. As a general rule, any part requiring an estimated 15 minutes or less of welding should be studied on an individual basis.

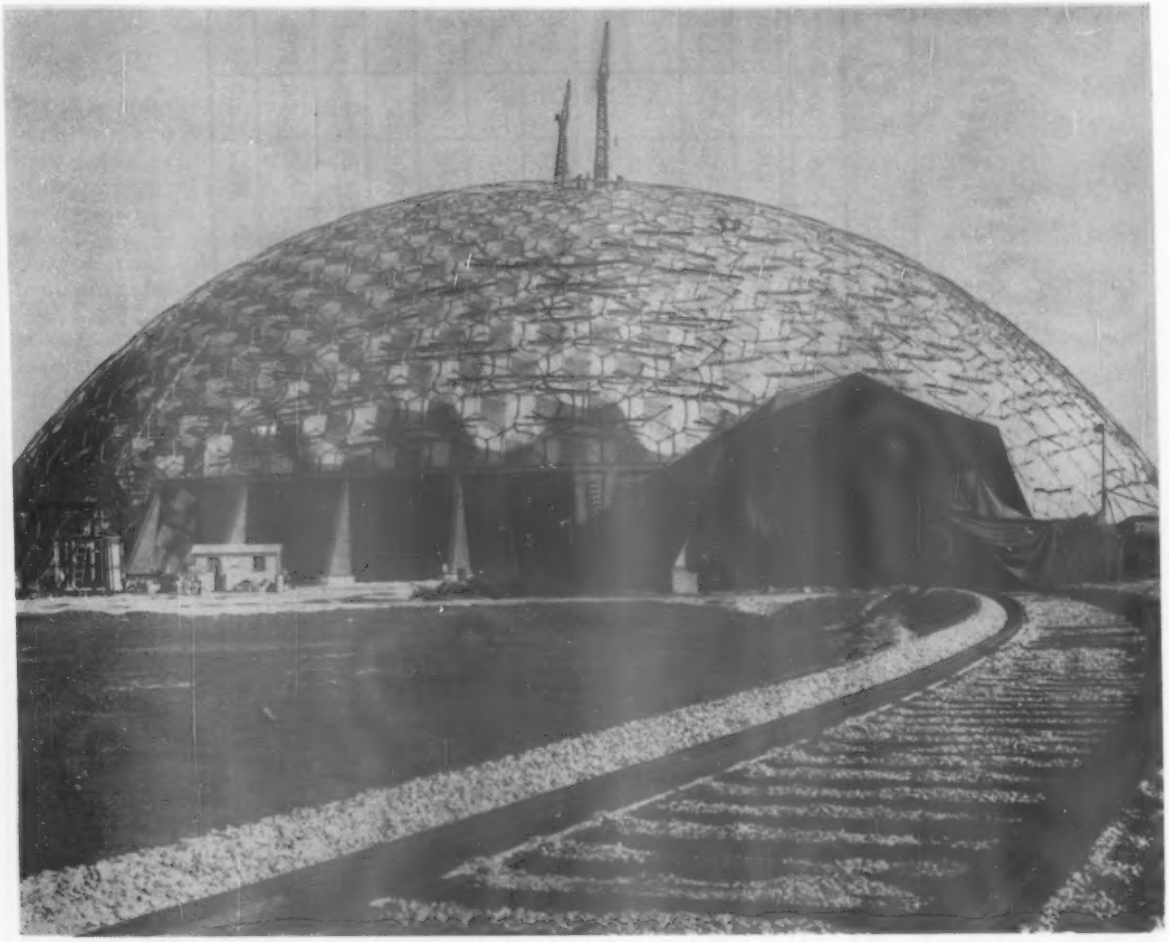
Average welding time in minutes for fillet and 45 deg bevel welds

Weld Size Inch	Wght Per Ft Lb	Minutes Per Number Of Linear Feet (Mild Steel Electrodes)																					
		1/4	1/2	3/4	1	2	3	4	5	6	7	8	9	10	20	30	40	50	60	70	80	90	100
1/4	.106	.663	1.33	1.99	2.65	5.30	7.95	10.6	13.3	15.9	18.6	21.2	23.9	26.5	53.0	79.5	106	133	159	186	212	239	265
5/16	.166	1.04	2.08	3.12	4.15	8.30	12.5	16.6	20.8	24.9	29.1	33.2	37.4	41.5	83.0	125	166	208	249	291	332	374	415
3/8	.239	1.50	2.99	4.49	5.98	12.0	17.9	23.9	29.9	35.9	41.9	47.8	53.8	59.8	120	179	239	299	359	419	478	538	598
7/16	.325	1.85	3.70	5.55	7.40	14.8	22.2	29.6	37.0	44.4	51.8	59.2	66.6	74.0	148	222	298	370	444	518	592	666	740
1/2	.425	2.27	4.53	6.79	9.06	18.1	27.2	36.2	45.3	54.4	63.4	72.5	81.5	90.6	181	272	362	453	544	634	725	815	906
5/8	.664	3.28	6.55	9.83	13.1	26.2	39.3	52.4	65.5	78.6	91.7	105	118	131	262	393	524	655	786	917	1048	1179	1310
3/4	.957	4.50	9.00	13.5	18.0	36.0	54.0	72.0	90.0	108	126	144	162	180	360	540	720	900	1080	1260	1440	1620	1800
7/8	1.30	5.93	11.9	17.8	23.7	47.4	71.1	94.8	119	142	166	190	213	237	474	711	948	1185	1422	1659	1896	2133	2370
1	1.70	7.60	15.2	22.8	30.4	60.8	91.2	122	152	182	213	243	274	304	608	912	1220	1520	1820	2130	2430	2740	3040
1-1/8	2.15	9.45	18.9	28.4	37.8	75.6	113	151	189	227	265	302	340	378	756	1130	1510	1890	2270	2650	3020	3400	3780
1-1/4	2.64	11.5	23.0	34.5	46.0	92.0	138	184	230	276	322	368	414	460	920	1380	1840	2300	2760	3220	3680	4140	4600

Note of explanation—*This chart is based on an average of approximately 45-50% arc time and 2 deposition rates: 0.04 lb/min (2.4 lb/hr) for welds ⅜ in. and under, and 0.06 lb/min (3.6 lb/hr) for all weld metal deposited above the first ⅜ in. Elements of welding, cleaning, positioning and handling, personal time and fatigue allowance are included in the chart time.*

Example—*What is the time required to weld 276-½ ft of ½-in. fillet weld?*

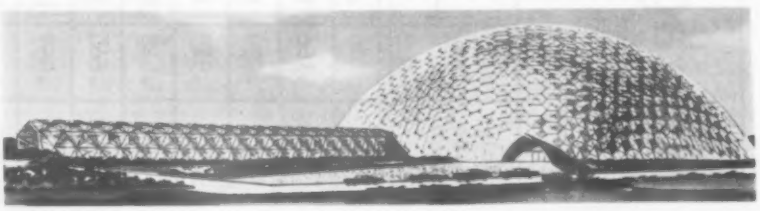
Solution—*100 ft equals 906 min x 2 equals* 1812.00 (200 ft)
634.00 (70 ft)
54.40 (6 ft)
4.53 (½ ft)
2504.93 (276½ ft) 2505 min



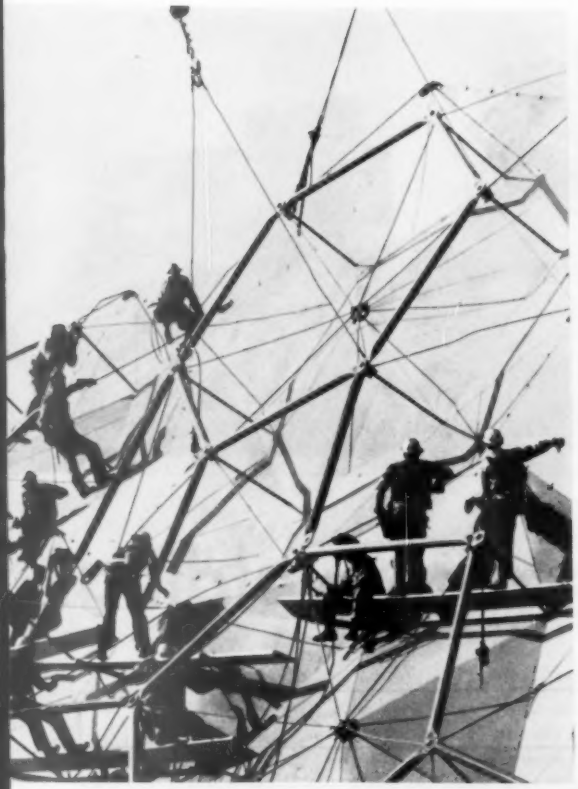
10 stories high . . . 110,000 sq ft . . . 375 ft in diameter . . . no internal supports

Geodesic steel dome is put to its first U. S. industrial use

All welded-steel hemisphere was built by Union Tank Car Co. in Baton Rouge to house railroad car maintenance shop

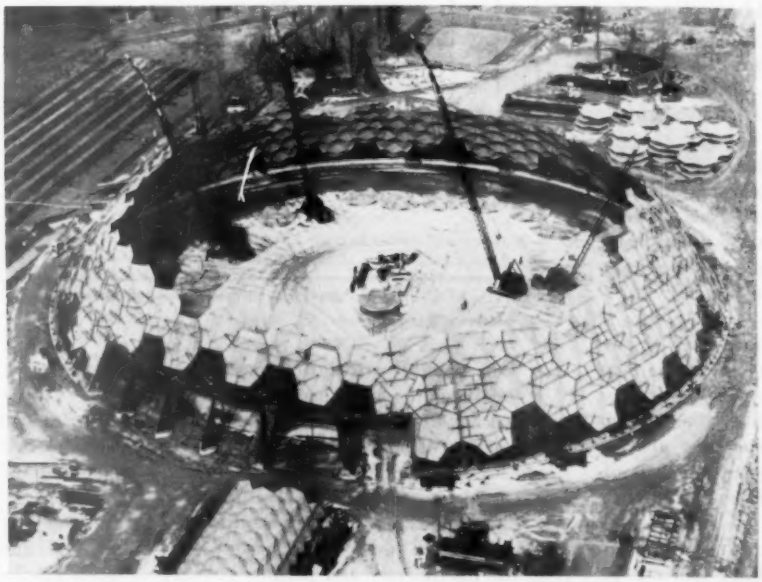


ARTIST'S conception of geodesic dome with 200-ft-long, 20-ft-high addition for painting tank cars. Building is being constructed by Nichols Construction Co., Inc., Baton Rouge, La.



PANEL, composed of diamond sections, is placed in position near top of dome. Once positioned, panel is tack welded, and area to be finish welded is cleaned with power buffer. Panel is then butt-welded using E6010 electrode. Two passes are required.

DIAMOND sections of 1/8-in. steel sheet panels are lap welded, each panel lapping the other by 1/8-in. *Inset*, weldor makes one downhand pass with E6013 electrode to lap weld seam. When welding is completed, slag is removed, and weld inspected.



AERIAL view of dome half completed. Power source is substation constructed at start of job. Station provides power for construction and will do so for railroad car repair shop when completed. From 110 to 440 volts are available. The dome and its facilities are expected to be in operation some time this month.

INSIDE view shows cranes used to lift panels for roof construction. Enormity of building can be seen when men (bottom, center) are compared to height of crane and dome. Geodesic dome is composed of 320 panels, with an outside grill of 4-in. steel tubing.

This article—devoted to the equipment and controls for resistance welding—is the first of a two-part series that will serve as a basis for several future articles on the four basic resistance welding methods: spot, seam, projection and flash-butt.

Resistance welding

by **Lester F. Spencer** . . . *Metallurgical Engineer*

OF THE MANY welding methods employed in joining commercial metals, resistance welding is considered by many to be the most economical *and* the simplest.

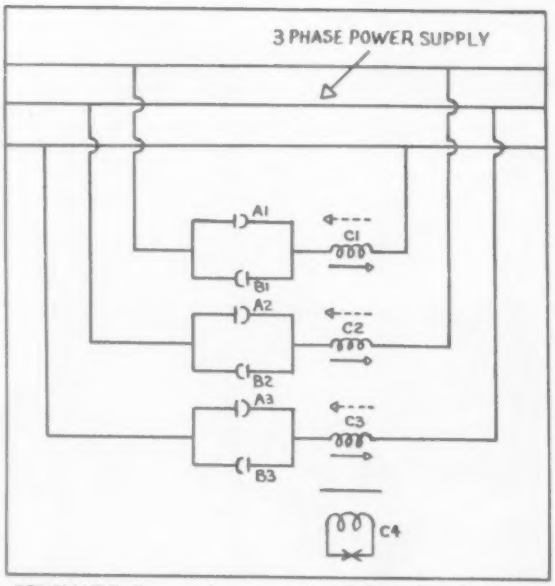
This process, which includes the spot, seam, projection and flash-butt methods, is characterized by the application of relatively high currents and pressures. Function of the current is heat generation within the joint in direct proportion to (*1*) the product of material resistance, (*2*) duration of current flow, and (*3*) the square of current amplitude.

In order to consistently obtain high-strength joints, however, two of the more important variables to be considered are *equipment* and the *material to be welded*.

In the equipment area, single-phase a-c machines are the "work horses." They are the most frequently used machine types in welding such materials as low-carbon steels, high-nickel alloys, titanium, etc. Light-metal alloys may be welded with either single-phase a-c or frequency-converter equipment, but the latter type is usually preferred.

Where power supply facilities are adequate, single-phase arc welders can be used with proper timing controls. However such welders can cause serious voltage disturbances which actually become critical when large-capacity spot or projection welding machines are installed. This problem has led to the development of various power systems that distribute a resistance welding load equally over three phases.

The frequency-converter system converts 60-cycle current to a lower frequency and the resultant increase in power factor permits the use of larger-capacity machines. As an example one commercial three-phase frequency-converter provides a current frequency range from 6 cycles per second to a maximum of 30 cycles per second.

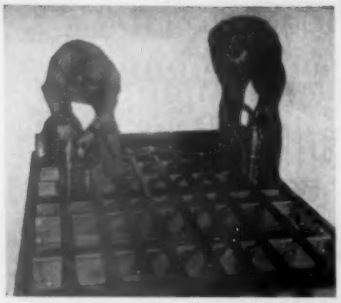


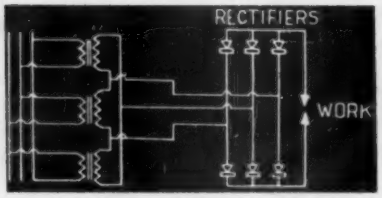
SCHEMATIC diagram shows operation of three-phase frequency-converter system.

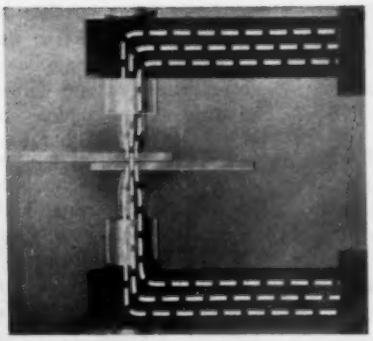
On specially designed equipment, frequency-converter machines have been built which can fire multiple impulses: 40 cycles on and 1 cycle off—a welding current frequency of about ¾ cycle per second. The low-frequency welding current may be either a single impulse per weld or it may be several impulses.

Care is taken to prevent saturation by reversing current for each weld; this feature cancels residual flux in the transformer and permits delivery of equal energy to each weld.

The frequency-converter welder has been used at Ryan Aeronautical Co. to weld a variety of materials: titanium, mild steel, stainless, and high-nickel and aluminum-base







procedures and design

alloys. A number of these machines are rated at 120,000 amp short-circuit current, and have an electrode pressure of 11,000 psi. Such units are capable of producing crack-free structural welds in two 0.187-in. steel sheets, or in two 1.125-in. sheets of aluminum.

The dry-disc rectifier system, used for spot, projection and seam welding, is also used to convert three-phase power to single-phase d-c. In this case, current flow at the electrode tips is unidirectional. One characteristic of importance here is control simplicity which permits minimum maintenance.

Three-phase welders offer these advantages:

1—Over-all load is less, and load per phase is even smaller than single phase.

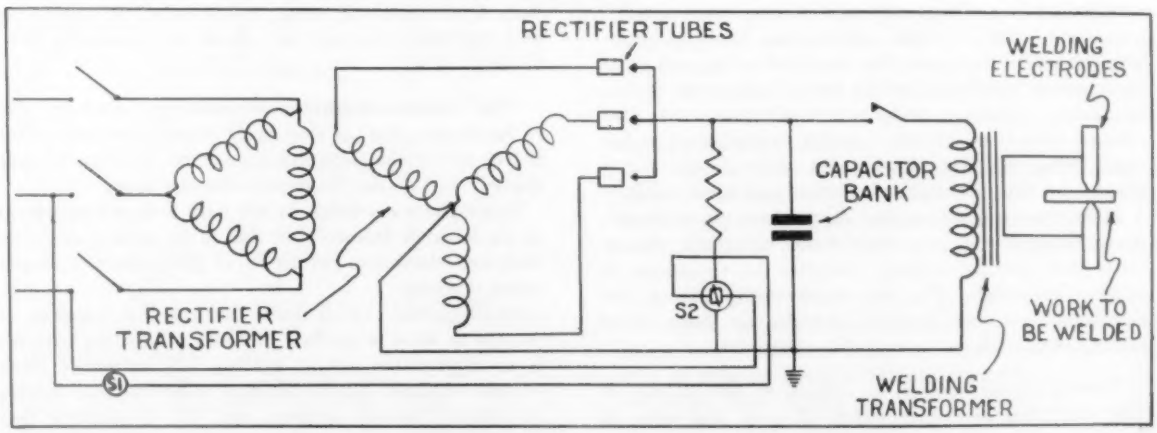
2—Demand of a single a-c machine increases substantially in proportion to throat depth, but demand of a three-phase machine increases only slightly.

As an example, Sciaky Bros. Inc., of Chicago, states that for a given secondary current at a 12-in. throat depth, the ratio of single-phase to three-phase line current is 2.8, and the ratio of single-phase to three-phase kva is 1.6. With an increase in throat depth to 24 in., line-current ratio is 4.2 and kva ratio is 2.6. At a 46-in. throat depth, line-current ratio is 5.5 and kva ratio is 3.7.

In welding high-conductivity alloys and materials with narrow plastic ranges, the equipment must have current capacity great enough to create the weld in as short a time as possible. And, if consistent welding results are desired, energy input for each weld must also be consistent. To help obtain this constant input factor, low inertia in the electrode holder and a movable head are desirable machine characteristics.

Electrostatic stored-energy welders were built to join aluminum alloys, and many of these machines are in use. This system takes electrical energy from power lines in small quantities and stores it in banks of capacitors. Thus, by accumulating during long intervals the short-time energy need for welding, these machines reduce

SCHEMATIC diagram of electrostatic type of stored-energy welding machine.



peak demand on the power supply.

Electrical energy for welding is taken from this reservoir at a constant rate, regardless of fluctuations that may occur in the primary that supplies energy to the storage system. In addition, current requirement is lower than that realized with conventional a-c equipment.

Results obtained from electrostatic welding equipment are dependent on such inherent welding variables as capacitor capacity, peak charging voltage, electrode force, etc. On the basis of considerable data obtained in spot welding aluminum alloys, for example, it has been determined that weld joint strength increases linearly with an increase of capacitor capacity. Also, an increase in capacitor charging voltage increases weld shear strength.

Both factors increase energy input to the weld, melt more metal and produce a larger nugget. Increased electrode force, however, may reduce weld strength. The lower contact resistance will thus produce less heat, melt less metal, and make a smaller nugget.

To obtain good welds, specifications for electromagnetic stored-energy welding should state values of welding and forging force, discharge time, setting for maximum current relay, and resistance used in the secondary circuit.

The percussion welding machine, used essentially for upset welding, is also considered a stored-energy type. Power is taken from a three-phase line, transformed and rectified to about 3,000 volts d-c, and used to charge a bank of capacitors.

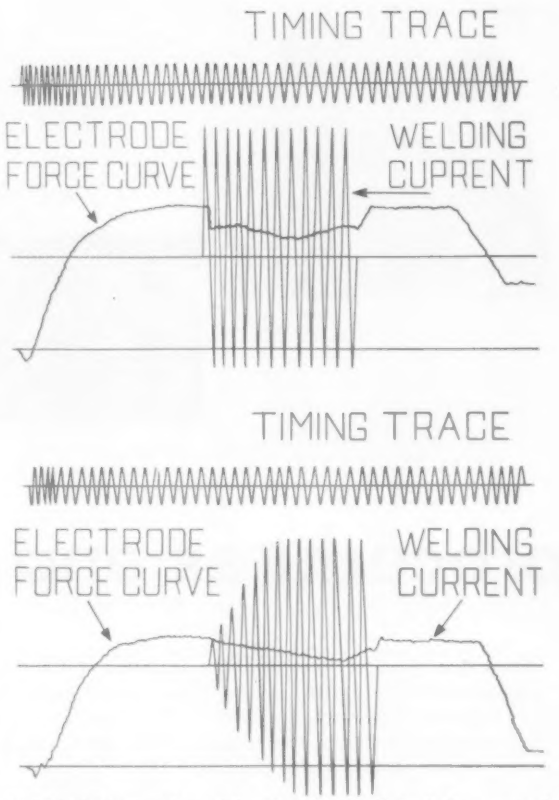
Up to this point, percussion welders operate much like electrostatic machines, but here the similarity ends. The electrodes, which clamp the work and carry current from the reservoir, travel swiftly toward each other. When they are within arcing distance, the capacitors discharge across the gap to create an intense heat on the surface being welded. When workpieces actually are in contact, the discharge is complete and the two pieces are forged together.

It is essential for the user to maintain close control over a resistance welding procedure. Just what type of control is used, however, is dependent upon material welded, equipment performing the work, and the design factor. In many instances, controls are incorporated in the equipment design to eliminate the human element.

In welding such materials as aluminum, magnesium and copper-base alloys, mechanical refinements for RW equipment could include anti-friction bearings, lightweight anti-friction heads for rapid follow-up, and greater structural rigidity of welder arms, holders and platens to minimize deflection under a high electrode force. (Decreased deflection will also prevent expulsion of molten metal while welding metals with little or no plastic range, and thus eliminate cavitation and weak welds.)

Aluminum, magnesium and copper-base alloys require the additional use of synchronous electronic timing, since they are particularly sensitive to variations in welding procedure. The use of electronic timing also eliminates transient currents which can burn holes through the work or destroy the electrodes.

Synchronous timing, as defined by the NEMA, is "the initiation and termination of each half-cycle of welding transformer primary current so that each half-cycle of such current is the same on successive welds." Conversely, nonsynchronous timing is "the initiation or termination of welding transformer primary current at any random time with respect to the voltage wave."



CURRENT force without *(above)* and with *(below)* slope control.

Checked against established standards of repetitive accuracy and accuracy of calibration, the synchronous timer is more accurate than the nonsynchronous type. Both control types meet the NEMA standard of repetitive accuracy (±10% above 10 cycles; ±1 cycle from 6-10 cycles; ±½-cycle up to 5 cycles). But in calibration, the accuracy for nonsynchronous times is ±20%, while the synchronous type is rated at about ±5%.

Generally, however, the synchronous timer is made with fixed one-cycle steps, which raise its calibration and repetitive accuracy far above the standards listed above.

The electro-magnetic stored-energy machine, due to its reactor, has an inherently sloped waveform. This is true also of the electrostatic machine (to a much lesser degree) and of the frequency-converter type.

Single-phase machines do not have a sloped waveform as an inherent feature—but due to its advantages, controls were devised to permit use of this feature on single-phase machines.

Slope control, which limits the first few impulses of current to allow a gradual build-up of welding current, is an appreciable aid in welding (*1*) extremely thick or thin sections; (*2*) in welding materials that exhibit a tendency toward spitting, and (*3*) in designs that

specify minimum edge distance where reduced electrode pressures are mandatory.

A further example of the function of slope control is found in welding aluminum, where it prevents electrode pick-up and sticking, and results in extended tip life. Reynolds Metals Co., for instance, has found that slope control extends tip life 20 to 30 times over that obtained from tips used in similar operations run without this control type.

But just how can slope control extend tip life?

To better understand this, the reader should know that the factor most detrimental to tip life when welding ferrous metals is deformation of the tip surface. When used to weld nonferrous metals, the electrode tip is most seriously affected by surface material it picks up from the workpiece.

Both deformation and pick-up are caused by excessive tip temperature. Without slope control, an electrode tip must carry full welding current on the first half-cycle before the tip actually gets a chance to seat itself properly on the material. The overheated contact area, therefore, can be slightly deformed every time it is brought into contact with ferrous metals—or it can burn and pick up some surface material from nonferrous metals. And even the most efficient water-cooling system won't prevent this from occurring to some degree.

When slope control is used, however, the first one or two cycles of weld time will be at reduced current density. As a result, the electrode contact area will meet the work fully before peak current density is applied.

A variable-pressure cycle is frequently incorporated in resistance welding machines. This form of control exerts both an initial pressure to prevent excessive sheet separation, and a follow-up or forging pressure which reduces any tendency toward porosity or weld cracks.

The magnitude of forging pressure naturally varies with material type and thickness, and the design aspect. But it can be generally stated that the value of forging pressure will be two to three times that of the initial welding pressure.

In welding aluminum-base alloys, variable-pressure cycles will permit a wider current range in which sound, crack-free welds can be produced. Machine settings therefore become less critical and good welds can be obtained on a production basis once the proper pressure cycle has been established.

Both pre- and postheat controls are mandatory in resistance welding hardenable carbon and alloy steels. They may be used in the same manner as slope control with reasonable success and, in addition, they may also be used for many different pulsation welding effects.

According to one authority, the addition of slope or pre- and postheat controls will permit a small welding machine to handle a job normally requiring a machine of greater capacity. The use of postheat controls with a variable-pressure system will permit the use of a lower forging force in which the point of application is less critical. (In this instance, a postheat time of at least 2 or 3 cycles is required for effective elimination of cracks.)

The extensive coverage given to the aircraft industry in the past decade and more points up the fact that its resistance welding applications are often critical. To consistently produce quality welds, Ryan Aeronautical Co.—for one—considers the following equipment and procedures mandatory:

1—A deflection firing system when welding aluminum: it (*a*) cuts welding current when pressure drops to prevent firing under light pressure; (*b*) provides increased control with less maintenance of pressure systems, and (*c*) monitors electrode pressure throughout the complete welding cycle.

2—Fixed increment heat and timing adjustments where duplication of work is essential.

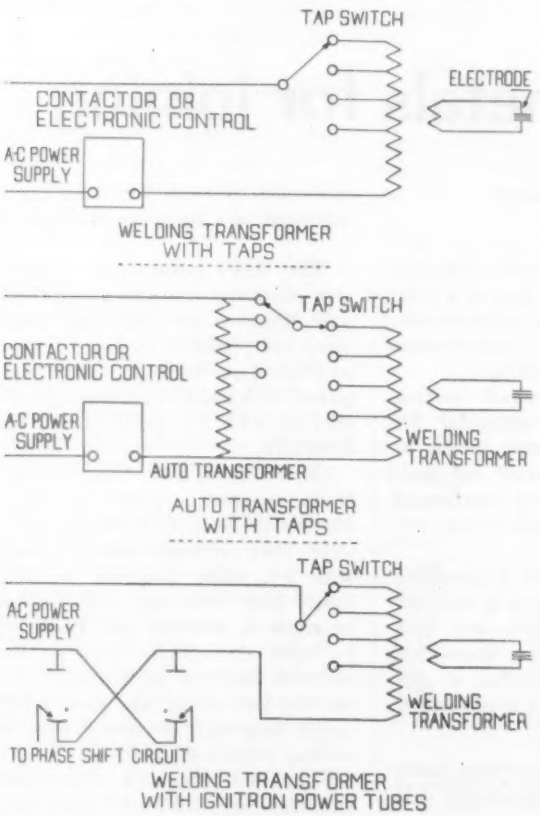
3—Roller-spot welders which can be used either for seam or for spot welding. These devices increase production rates and assure accuracy in weld spacing, but can be used only on readily accessible joints.

4—Reduced heat for the first spot weld to compensate for the "shunt" effect, and to eliminate splash and cracking in critical assemblies.

5—Series/parallel tap switches to save time in setting-up major changeover jobs on large machines. A series/parallel transformer tap system is essential where fine heat control is desired and a wide range of work is welded.

6—Uni-polar, plus-or-minus firing where it appears that uniform penetrations in sheets of different thicknesses can be made by using the "drift" due to the direction of welding current. (Drift frequently is an important factor in obtaining proper heat balance.)

DIFFERENT methods of varying welding current or heat.



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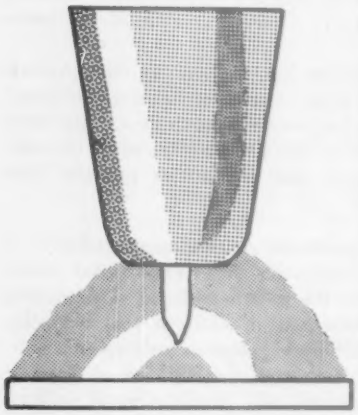

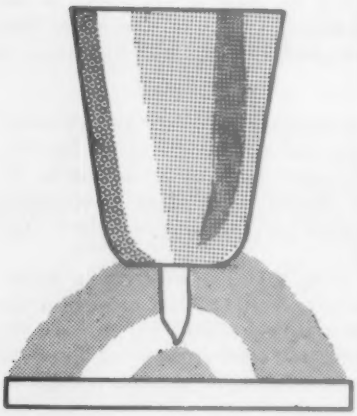

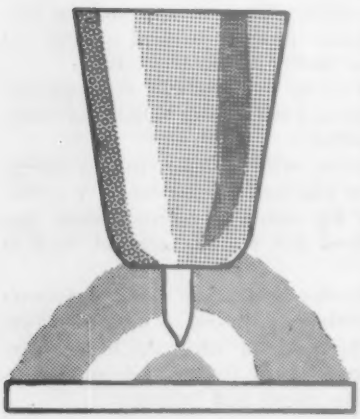

". . . THE principle behind Tig welding is an arc drawn between a tungsten electrode and the work, and protected by an inert gas."

Filler metals for joining

By Orville T. Barnett*

ALTHOUGH TUNGSTEN electrodes are not actually part of a joint in the same sense as filler metals, their abilities as a heat source make them important in welding.

Tig (tungsten inert-gas) welding has proved highly successful for welding such nonferrous metals as aluminum, copper, nickel and their alloys, and for joining nonferrous base metals like titanium and zirconium.

The principle behind Tig welding is an arc drawn between a tungsten electrode and the work, and protected by an inert gas. Atomic-hydrogen welding—somewhat a specialty these days—uses *two* tungsten electrodes, between which an arc is sustained in a hydrogen atmosphere.

The three basic types of tungsten electrodes (pure tungsten, thoriated tungsten and zirconium tungsten) are produced in four common analyses (*see* Table 1). Their simplified chemical breakdowns are covered by AWS A5.12-55T and ASTM B297-55T.

Of the three, pure tungsten electrodes are least expensive and therefore should be applied whenever possible. They are most commonly used with a-c, either balanced or continued high frequency, with helium or argon as shielding gas. However, in argon atmospheres, tapering the electrode improves performance. Arc stability with a-c is quite good. EWP (pure tungsten) electrodes have a melting point over 6,000 F.

Thoriated tungsten electrodes (EWTh-1 and EWTh-2) have two

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TABLE I

AWS-ASTM classification	Tungsten % (minimum)	Thorium %	Zirconium %
EWP	99.5	—	—
EWTh-1	98.5	1	—
EWTh-2	97.5	2	—
EWZr	99.1	—	0.4

thorium contents, 1% and 2%. Although more expensive than pure tungsten electrodes, they do possess many advantages when applied with d-c straight polarity, but exhibit no superiority with d-c reverse polarity or with balanced a-c.

The added thoria (ThO_2) improves arc stability (electron emissivity of EWTh-1 is about six times that of EWP electrode), and several other features. It gives:

(1) Easier arc starting—particularly at low open-circuit voltages.

(2) Greater arc stability.

(3) Broader operating current ranges for a given electrode size, which often eliminates changing electrodes when joining base metal parts of varying thicknesses. This characteristic is most pronounced when d-c straight polarity and helium are the power/gas combination.

(4) Lessened susceptibility to sticking in touch-starting.

(5) Decreased tendency for the electrode to stick to the work.

(6) No contamination of the work with tungsten inclusions if the electrode is accidentally touched to the weld pool. This is true because thoriated electrodes do not melt at the tip if proper application conditions are followed. Electrode consumption is almost entirely through volatilization, which also lessens inclusions.

(7) No erratic arc transition from high frequency initiation to straight d-c continuation during welding.

EWZr electrodes are least popular in commercial use. Their advantages are confined chiefly to welding aluminum and aluminum alloys with a-c high frequency.

Electrode diameter and current magnitude choices for tungsten electrodes will be influenced by the type and thickness of metal to be joined. For general purposes, however, the thicker and more heat-conductive metals require larger diameter electrodes and more current.

But with any given electrode size, more current can be used with d-c straight polarity; less with a-c, and still less with d-c reverse polarity *(see Table 2)*.

The current-carrying capacity of tungsten electrodes also depends upon the shielding gas, electrode length beyond the collet, cooling efficiency of air- or water-cooled electrode holders, welding position, and current type and polarity.

Although Table 2 suggests values for a number of current and gas combinations, considerable care must be exercised in choosing proper electrode diameter for a specific weldment. The goal is to operate at the highest temperature consistent with long electrode life.

Current density which is too high in a helium atmosphere leaves a black tungsten deposit on the work. Current density which is too low leads to unstable, erratic arcs.

Fig. 1 illustrates appearance of *(a)* pure tungsten electrodes using proper a-c or d-c; *(b)* thoriated tungsten electrodes using d-c; *(c)* all tungsten electrodes if excess a-c or d-c is used, and *(d)* all tungsten electrodes if insufficient a-c or d-c is used.

Tungsten electrodes are comparatively expensive; therefore, correct electrode usage will promote economy and improve weld quality. A number of simple steps will help conserve your electrodes.

Use appropriate current values for each electrode diameter. Too much current causes excessive melting, dripping or volatilization of the electrode. Too little current leads to

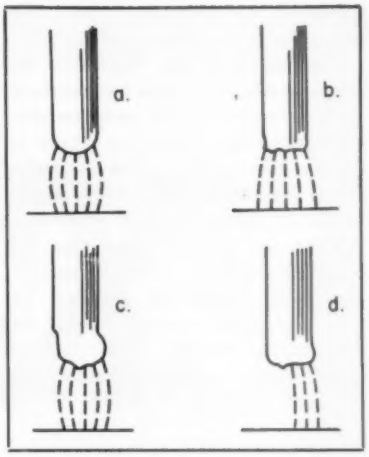

FIG. 1. Appearance of four tungsten electrodes with proper and incorrect currents.

cathode bombardment and erosion because of low temperature.

Break the electrode by nicking it with a grinding wheel and then snap it off, using pliers to hold it close to the nick.

Break the electrode near the end, at which point its first ¼ in. to ⅜ in. of length is brittle. If this is not done, a jagged break or bent electrode will result. Irregular electrode ends usually cause a poorly shaped arc and overheat the electrode.

The manufacturer cleans the electrode surface by chemical means or centerless grinding. Work tests, particularly when high production is involved, will indicate if the high current-carrying capacity of centerless ground electrodes is more economical than that of chemically cleaned electrodes, despite the former's higher initial cost. Both electrode types should be packaged un-

TABLE II

Electrode diameter (in.)	Balanced a-c helium	Balanced a-c argon	Unbalanced a-c argon	D-c str. pol. helium	D-c rev. pol. argon or helium
0.010	—	<15	—	<6	—
0.020	—	10-20	—	15-25	—
0.040	—	20-30	—	20-50	—
1/16	25-30	30-80	40-120	50-150	10-20
3/32	30-50	60-130	100-180	100-250	15-30
1/8	40-80	100-180	150-225	200-300	25-40
5/32	45-115	140-240	200-275	240-325	35-60
3/16	50-150	180-300	250-325	275-350	40-80
1/4	60-250	250-400	300-450	300-450	80-125
5/16	—	—	450-675	—	—

TABLE II Suggested current ranges for tungsten electrodes.

til ready for use to gain maximum protection against dust and dirt.

Maintain inert gas flow after the arc is broken and until the electrode cools. Properly cooled tungsten electrodes are mirror-bright, or silvery, at the tip. Improperly cooled electrodes reveal oxidation by a blue, black, brown or greenish-yellow coating.

Minimize electrode projection beyond the shielding nozzle in accordance with limitations imposed by joint design and maneuverability requirements. Shorter exposed electrode lengths assure protection even at lower gas flow rates.

Avoid contaminating the base metal or welding rod by touching it with the heated electrode. This is particularly true when working on aluminum.

Keep the electrode holder—and especially the shielding nozzle—clean and free of weld spatter. Dirty nozzles encourage arc wandering, lead to poor welds and, through excessive electrode consumption, raise costs.

Table 3 lists the principal suppliers of tungsten arc-welding electrodes. Note the limited production of zirconium-bearing electrodes as compared to the other types.

"RIDE a white horse [Tig welded, of course] to Banbury Cross," might well be the rhyme to accompany the joining of this aluminum hobby horse.

TABLE III

Comparison of commercial Tig welding electrodes

AWS-ASTM Designation

Supplier	EWP	EW Th-1	EW Th-2	EWZr
Air Reduction Sales Co.	"Airco" pure tungsten	"Airco" Thor-Tung 1%	"Airco" Thor-Tung 2%	"Airco" zirconium tungsten
Cleveland Tungsten, Inc.	"Pure Cleve-Tung"	"R. F. Cleve-Tung"	"S. K. Cleve-Tung"	—
Hobart Brothers Co.	"Pure-Tung"	1% thoriated	2% thoriated	"Zirtung"
Linde Co.	"Heliarc" pure tungsten	"Heliarc" tungsten 1% thoriated	"Heliarc" tungsten 2% thoriated	—
National Cylinder Gas Div.	"NCG" pure tungsten	"NCG" 1% thoriated tungsten	"NCG" 2% thoriated tungsten	—
North American Phillips Co.	"Elmet Pure"	"Elmet" 1% thoriated	"Elmet" 2% thoriated	—
Sylvania Electric Products, Inc.	"Puretung"	1% thoriated tungsten	2% thoriated tungsten	"Zirtung"
Westinghouse Electric Corp.	Pure tungsten	Thoriated tungsten 1%	Thoriated tungsten 2%	—

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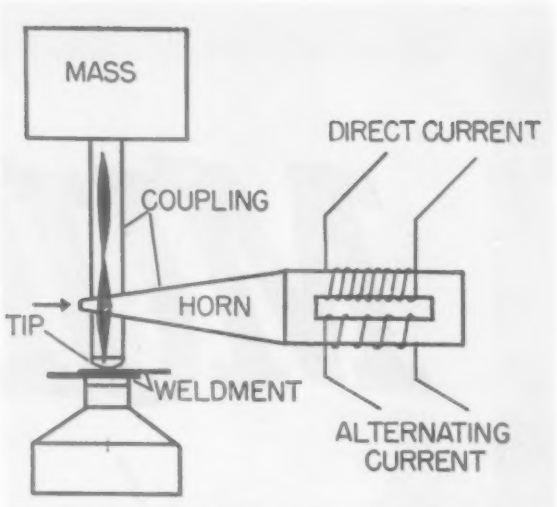
Ultrasonics: a "sound" welding technique



TYPICAL ultrasonic welder. Electrical energy flows through transducer, which translates it to ultrasonic energy for welding.

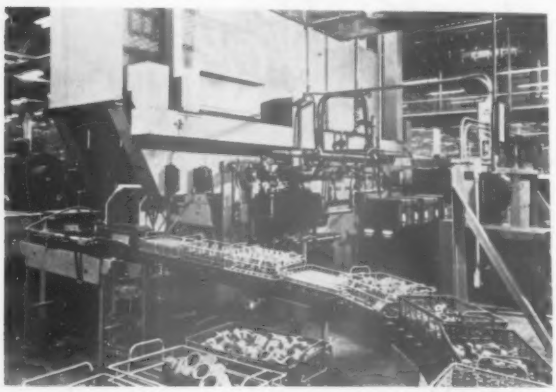
ASTUTE WELDING ENGINEERS are closely watching a field that bids to revolutionize the welding industry. That field is ultrasonics.

But to learn how and why, we must go back to 1883—the year the ultrasonic dog whistle was invented. Sound, as you probably know, becomes inaudible to the human ear when it reaches 20,000 cycles, although the waves continue to higher levels.

Capitalizing upon this phenomenon, an ingenious gentleman named Galton developed a whistle producing 25,000 vibrations per second. Dogs could hear its shrill notes; humans couldn't. Here was the first practical application in the now-burgeoning development of ultrasonics.

What can ultrasonics contribute to welding? Let's start from the beginning: it can clean or degrease metals, swiftly and efficiently; it can join dissimilar (or similar) metals below their melting points; it can locate weld flaws undetectable by X-ray, and it could free welding shops of contaminating dusts.

An impressive list, but how do ultrasonics work? Ultrasonic energy is actually vibrational energy, some scientists believe. But all researchers agree it is produced by means of a transducer, a device which converts electrical energy into ultrasonic energy. There are two means of producing these high-frequency waves: magnetostriction and piezoelectricity. In the end, however, the waves given off are the same.



AUTOMOTIVE machine parts are cleaned ultrasonically. Placed in steel baskets, parts are carried through cleaner and degreaser in time cycles. Only a few seconds are required for cleaning and degreasing.

Magnetostriction is premised on the fact that subjecting a piece of metal predominantly nickel to a magnetic field will cause it to change its dimensions slightly. When alternating current is added, the nickel rod will vibrate, emitting sound waves.

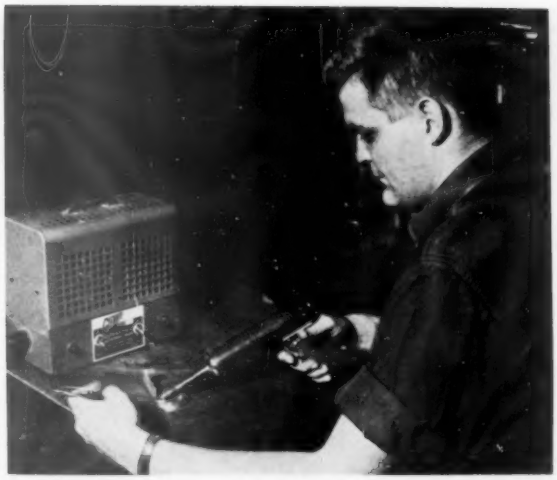
Piezoelectric substances build up an electrical charge when "squeezed". If a voltage is applied, these substances will alter their shape, causing vibrations and so releasing ultrasonic energy like magnetostrictive substances. Materials can be natural—Rochelle salts, ammonium dihydrogen phosphate and quartz—or man-made—barium titanate ceramics.

Such high-cycle sound can perform many operations. One of these is cavitation, or "cold boiling." This occurs when ultrasonics are driven through a liquid, their best medium. Tiny bubbles of dissolved air form, which, at peak efficiency, collapse in the direction they are aimed. Introducing an electrical force at this point generates a shock wave that builds pressures from 10,000 to 100,000 atmospheres.

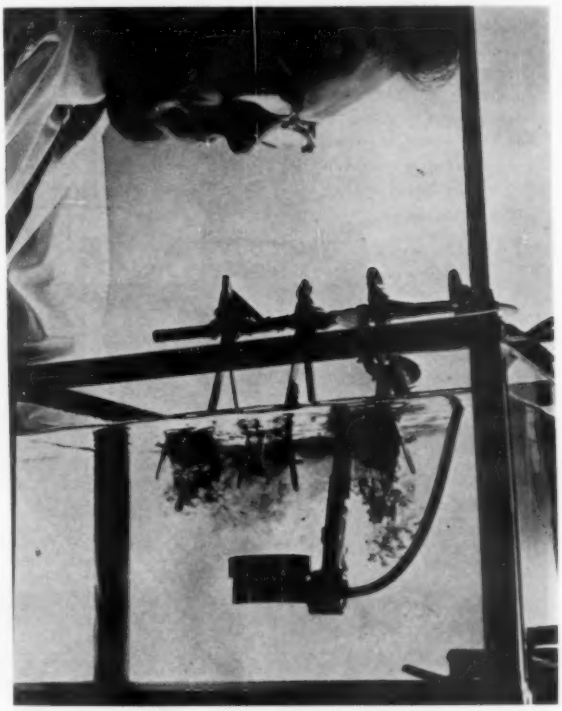
Should metal be immersed in the liquid, says Gulton Industries, Inc., Metuchen, N. J., producers of ultrasonic equipment, "cold boiling" liquid tears away any dirt clinging to its surface.

Cavitation has been of great value to the medical and dental professions. Because of its unique cleaning abilities, cavitation searches out areas on instruments that would otherwise be impossible to reach by ordinary methods.

But ultrasonic's medical services are not confined to cleaning instruments. The high-frequency waves can be focused and, because of this, doctors burn cancers and tumors with them; some tissue has stopped growing after the treatment. Projected, too, is extensive use of ultrasonics in dental drills.



LEFT: Soldering aluminum to stainless steel disc with ultrasonic soldering iron. Tips may be either gas or electrically heated. Read accompanying article for further details. BELOW: Cavitation, or "cold boiling" is used to clean this optical instrument. Mild detergents can be added if harmless to objects being cleaned. Worker could put hands in water as it is not hot.



In the welding field, ultrasonics can solder—and weld—aluminum, magnesium and their alloys as well as welding dissimilar metals. Aluminum, of course, is difficult to solder because it, like magnesium, instantly oxidizes; preventing adhesion of the molten metal.

In ultrasonic soldering, however, the tip is driven at high-frequencies by a transducer. The sonic field abrades the surface of the metal, allowing the solder to form an alloy band before further oxidation takes place.

Also done ultrasonically is seam welding (see page 78 in *WE*, June, 1958). Gulton, which produced such a seam welder, states the machine accepts metal up to 0.010 in. thick and welds it to similar or dissimilar materials up to 5 in. thick or more.

Degreasing is minimized and the metals are joined solely through high-frequency sound. A molecular transfer, or plastic flow, is created at the interfaces, *below the melting point of either metal.*

Battelle Memorial Institute is testing a similar welder for the Air Force in its Columbus, Ohio, laboratories. Battelle has this to say about ultrasonic welding: "Since little pressure is required to effect the weld, deformation of the metal is kept at a minimum. Moreover, the heat generated when the weld is made is localized and is quickly dissipated, making ultrasonic welding a cool process."

What causes sound to join metals? Physically, a transducer is formed by wrapping laminated nickel sheets with a coil. When a-c is passed through the coil, the nickel expands and contracts rapidly. This magnetostrictive vibration is shunted to an acoustical velocity transformer, or horn, and concentrates at its point, which serves as a welding tool.

Thin metal strips are welded by laying one on top of the other and pressing them against the horn. With low clamping pressures, it is possible to obtain a strong weld in a matter of seconds.

What causes the bond? That is a question that Battelle, among others, is trying to answer. It might be due to diffusion, recrystallization, mechanical interlocking, fusion or, possibly, a combination of all these.

Whatever the reason for sound welds, the technique promises to become more prominent as newer and larger welders are developed—a project that is rapidly gaining momentum.

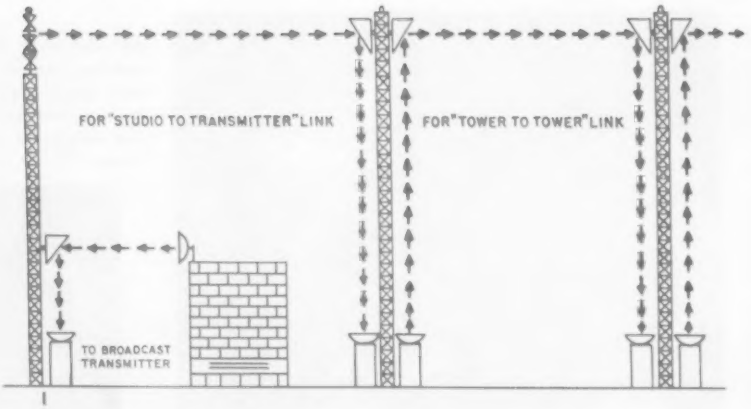
Once a weld is completed it can also be tested by ultrasonics. "Ultrasonograms", like sonar, will be able to chart obstructions, whether they be in flesh or in metal. This technique is frequently applied when other testing systems fail.

Another possibility for adoption in welding shops is Gulton's "Multiwhistle." Ultrasonics, which travel readily through liquids and solids, do not move as easily through air. The Multiwhistle is designed to correct this deficiency.

As high-frequency waves pass through air, they cause dirt particles to vibrate. Vibration forces the particles to collide and to adhere. When this happens, they become heavy and fall to the ground.

The firm expects the Multiwhistle to be used to dissipate fumes and smog. It has also been successfully tried for reclaiming carbon black from industrial chimneys. And, although no experimentation has been done in welding shops, the method should be capable of removing noxious fumes created by torches and arcs.

Even though ultrasonics are, at this stage, a young man learning and testing his strength, they appear destined to become a lusty giant, able to serve many aspects of our life.



RIGHT: Left side of diagram illustrates how a reflector is utilized to transmit microwaves from studio to tower. Right side demonstrates how reflectors relay signals from tower to tower. BELOW: Operator Tig welds a reflector support composed of 2-in. diameter, 0.083-in.-thick aluminum tubing. When entire unit has been completed it will be painted or anodized against corrosion.

TV to you —through welding

CUSHION SHOTS are a common technique among billiard players (and are often used by golfers blasting out from behind trees). "Cushion shots" are also employed to relay television pictures from broadcasting studios into thousands of homes.

What happens is this: as microwave signals are sent from a television studio, they flash across the sky until they reach an aluminum reflector mounted on a transmission tower. When they strike this reflector, they bounce downward to a parabolic receiving antenna. They are then transmitted to a coaxial cable, which carries them to a broadcast transmitter and then shoots them across country.

Another type of "cushion shot" is used to send the same signals from tower to tower. In this, waves are reflected from the top of the tower at a parabolic antenna located on the ground. From here, a coaxial cable picks them up, boosts their intensity and beams them overhead to a second reflector from which they are sped horizontally to yet another tower.

Over 2,500 of these reflectors have been fabricated. Tower Construction Co., Sioux City, Iowa, their manufacturer, states the devices eliminate the need for costly coaxial feed lines up the tower. Besides being expensive, these lines are sources of power losses and mechanical and electrical problems.

But when you build one part to replace another, you must be sure of two things: it will cost less and it will last longer. For most kinds of fabrication there is only one way to attain that goal—welding.

Tower knew that the thin aluminum sheet it must work with—often as fine as 0.031 in.—would be difficult to weld to the 2-in. diameter, 0.083-in.-thick aluminum tubing frame. Sizes, too, would present some problems. Reflectors ranged from 4 ft by 6 ft to 10 ft by 15 ft, with some special reflectors as large as 50 by 100 ft.

Best and least expensive way of doing the job, they figured, was by Tig (tungsten inert-gas) welding. Using Linde Co. equipment, they deposited RS5B bare aluminum rod under a protective atmosphere of high-purity argon. Tig welding the metal allowed higher welding speeds and sure joining, bringing fabrication costs down to a minimum.

With this economy comes strength. The shields are built to resist winds up to hurricane velocity. Although reflector faces may be solid or perforated, wind tunnel tests show that a 50% perforation reduces wind pressure by 48%.

Not only are the reflectors effective for television but they also can relay telephone, radio and radio-teletype communications. And, if we can paraphrase the florists, the moral of all this is: "Say it with welding."

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The consistent high quality of King brand bright finish welding electrodes and rods is achieved by rigid production and inspection controls, including radiographic and destructive testing of actual welds.

Available at leading welding supply distributors across the country. Call your local Kaiser Aluminum sales office, listed in your phone book, for additional information.

Kaiser Aluminum & Chemical Sales, Inc., 919 N. Michigan Avenue, Chicago 11, Illinois.

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Available In A Broad Range Of Alloys		
One and ten pound spools and straight lengths. Diameters ranging from .030 to ¼ inches.	1100	5154
	4043	5183
	5052	5254
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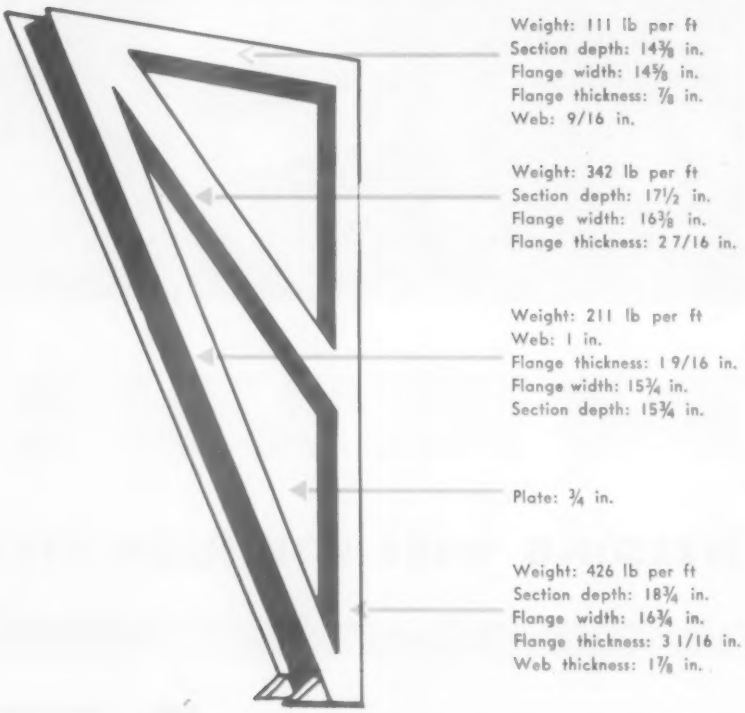
KAISER ALUMINUM

THE BRIGHT STAR OF METALS

Unusual design guarantees clear view of sports

by E. A. Moenning
International Steel Co.
Evansville, Ind.


Weight: 111 lb per ft
Section depth: 14⅜ in.
Flange width: 14⅝ in.
Flange thickness: ⅞ in.
Web: 9/16 in.
Weight: 342 lb per ft
Section depth: 17½ in.
Flange width: 16⅜ in.
Flange thickness: 2 7/16 in.
Weight: 211 lb per ft
Web: 1 in.
Flange thickness: 1 9/16 in.
Flange width: 15¾ in.
Section depth: 15¾ in.
Plate: ¾ in.
Weight: 426 lb per ft
Section depth: 18¾ in.
Flange width: 16¾ in.
Flange thickness: 3 1/16 in.
Web thickness: 1⅞ in.

PHOTOGRAPH at top of page shows completed sports center but here is the building's bone and sinew, a network of trusses and haunches. A drawing of the latter to be seen above.

IN GREEK LEGENDS, Atlas is said to have borne the weight of the world on his shoulders. In American reality, welding carries loads almost as great.

On a municipal sports center recently completed in Evansville, Ind., for example, welds at one point must hold in check stresses as high as 1,433 kips [1 kip equals 1,000 psi].

These tremendous strains develop on the vertical members of sixteen triangular haunches supporting the other ends of the eight basic framing members of the structure. Each haunch weighs 14 tons.

Welded to the upper and lower chords of the eight center-pinned main trusses, which have a free span length slightly over 267 ft, the haunches are pinned at their bases to hinge plates set in concrete piers. This provides a non-rigid structural frame. But supporting the 640 tons of steel in the main trusses demands a strength similar to that of Atlas . . . welding has that strength.

The brick building is slightly more than 312 ft long and has an unobstructed interior area of 83,017 sq ft. The concrete-covered arena, which can be flooded for an ice rink or topped with a hardwood flooring for basketball, is novel inasmuch as it is 19 ft 3 in. below grade level, permitting seats to be grouped around it on concrete steps poured from grade level.

This feature lowered the cost of the seating area, which accommodates 7,500 permanent seats and 4,000 temporary bleacher seats. In addition, it reduced the building height necessary to house so many people with a consequent reduction in steel costs.

From grade to center pins, the building is only 39 ft high. Vertical members of the winged haunches rise 27 ft. Total weight of structural steel—including 10 lightweight trusses tying into the main trusses at right angles to help support roof beams and purlins—exceeds 1,000 tons. More than 12½ tons of welding electrodes were consumed in the shop and in the field.

Haunches were shop fabricated and welded. Formed of ¾-in. plate framed by wide-flanged H-beams, the haunches are reinforced by a diagonal beam running from the lower truss chord connection to the top corner in such a way as to parallel the diagonal members of the trusses.

CLOSER view of center end of a top truss chord, a 14 WF H-beam, 111 lb per ft. Rounded tabs are shop welded into place, and then drilled for a 5½-in. diameter center pin which ties the two truss halves together. Over 25,000 lb of welding electrodes were consumed in shop and field assembly of the sports center.

These members had to be flame-cut to permit "wrapping" around the center plate. Principal joints were beveled at 45 deg one side of the flange-to-flange juncture, leaving a 1/16-in. nose on the bevel for accurate fit-up.

Welding included use of E6024 and E6027 iron-powder-coated electrodes, supplied by Lincoln Electric Co., Cleveland. The E6024 electrodes were used for fillets, the E6027 for multipass, deep-groove welds.

On some joints, as many as 35 passes were required to fill the groove. One such case occurred when a 3 1/16-in. flange was joined to a 2 7/16-in. flange.

This drag-type electrode was for flat position work only. It can travel as much as 50% faster than a conventional E6010 electrode, principally because of the higher current setting possible (weldors found that with a-c, the electrodes produced less spatter and somewhat higher welding speeds).

Center plates and vertical beam flanges on the haunches were predrilled so a locating pin could be inserted to position the parts for welding. Later, these holes were increased to 6½ in. diameter to accept a round mounting pin. This pin passes through the two flanges and the center plate, permitting an in-and-out rocking action on the foundation pier.

At the job site, the haunches were set on the piers and guy cables held them true while connections at top and bottom chords were made. With the haunch weight being "off-center", so to speak, it tends to counterbalance the trusses' roof load.

The tapered center-pinned trusses themselves were fabricated in sections. Although two half-trusses were pinned to make the full truss, transportation problems dictated that each half-truss be made in two parts, shipped to the construction site, and there spliced by welding.

Top chords of the trusses are 14 WF beams weighing 111 lb and 136 lb per ft. Bottom chords have 87, 167, and 264 lb-per-ft sections. These are joined by vertical and diagonal members—each comprising two 5 by 5 by ⅞-in. angles—skip welded back-to-back before being positioned and welded to gusset plates in chord channels.

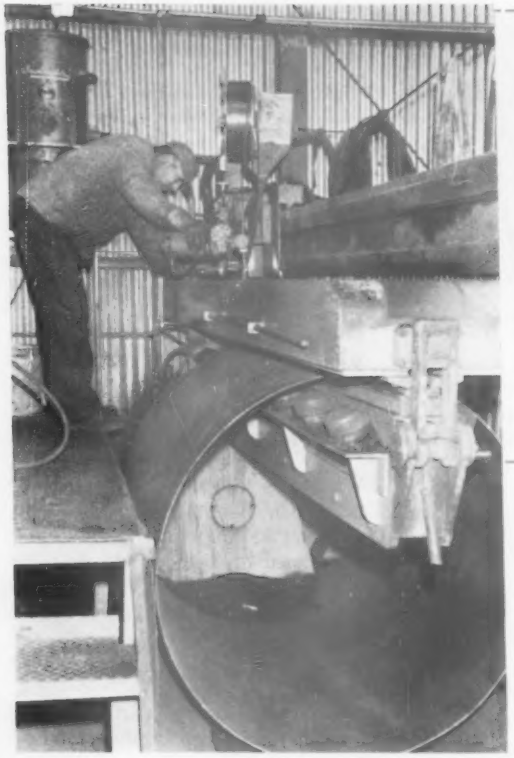
In the field, the partial trusses were welded at about the center to form the half-truss. This welding was done before they were hoisted into position for attachment to the haunches and before center pinning with 5½ in. round pins. This work was aided by a crane and by a high platform located near the center.

Fit-up between truss chords and haunch had already been carefully gaged in the shop. In the field, the two members were bolted together until they could be welded.

Stresses are considerable on such wide spans. For example, at the point where the bottom chord is welded to the vertical haunch beam, stress is calculated at 1,168 kips; on this vertical member, stress is estimated to be 1,433 kips.

Holding perfect post-weld alignment presented another problem—tolerance on the length from center pin to haunch base was held to ⅛ in., because pinholes were drilled after shop welding. But the partnership of extremely heavy beam sections and sound welding procedures minimized any distortion.

This was an all-Evansville job. International Steel Co. fabricated the steel in its shops; Ralph Legeman & Associates were architects; contractor was Thorp Construction Co, erection by Midwest Erection Co.



Welding makes these tanks "Superior"

AFTER roll-forming, shell section has longitudinal seam joined on automatic submerged-arc welder. Mild steel product is to be used as a filter tank for a swimming pool. Plate is ¼ in. thick and welding speed is 36 ipm at 700 amp, 32 volts. Wire is 3/16 in. diameter. Current is provided by c-p rectifier machine.

By Fel Tancula

WELDING has made the products of Superior Tank Corp., Tucker, Ga., just that—superior.

The firm, located just east of Atlanta, manufactures tanks for storing propane and other liquified-petroleum products, as well as hot water and similar tanks. They range in capacity from 4 gallons to 6,000 gallons.

All tanks to be used for storing LP products are fabricated in accordance with the ASME code for unfired pressure vessels. For these, Superior uses a high-tensile, low-alloy steel of firebox quality—in this case 75,000 psi tensile strength. For various non-code work, mild steel is of sufficient strength, but 90% of all tanks produced by Superior are fabricated from the high-tensile material.

Vessels range in wall thickness from 12 gage to ¾ in.

Welded Automatically

Tank heads are pre-formed at the mill, but the plate that is destined for the center section(s) is received flat. After having been sheared to size, the plate is roll-formed, then brought to an automatic submerged-arc welding station, where the longitudinal seam is made on a horn welder.

After this joint has been welded, section edges are offset so they will fit into the end heads. At this point, necessary openings (for nozzles and other brass work) are flame-cut into the shell. (Superior prefers oxypropane for its cutting operations.) The heads are then forced onto the shell and tack welded manually.

Offsetting is performed only on

GRINDING helps clean edges of shell sections prior to welding to heads.

HEAD is manually tack welded to shell, preparatory to automatic girth welding. On mild steel tanks, welders use E6024 electrode; on high-tensile, low-alloy material, E7020 is used.

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TEMPILSTIKS° provide a simple and accurate means of determining preheating and stress relieving temperatures in welding operations. Tempilstiks° are widely used as a standard method of checking temperatures in all heat treating—as well as in hundreds of other heat-dependent processes in industry. Available in 67 different temperature ratings . . . . . $2.00 each.

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TWO automatic heads on boom weld both head sections to shell simultaneously. On this particular job, 11/32-in. high-tensile plate for propane tank is welded at 34 ipm.

tanks with wall thicknesses of 3/8 in. and smaller. On heavier plate, edges are beveled 35 deg down to a feather edge, providing an included angle of 70 deg when plates are brought into position for welding. A steel back-up bar of the same high-tensile quality is manually welded inside the head at the beveled edge.

For non-code work where mild steel is involved, all manual welding is accomplished with an E6024 iron-powder electrode, usually 1/8 in. in diameter. On high-tensile, low-alloy material, two sizes of an E7020 low hydrogen, iron-powder electrode are employed—3/16 in. and 1/4 in.

Power source for all manual welding is a-c transformer; at automatic stations, it's d-c constant-potential rectifier.

2 Heads on Girth Welder

The submerged-arc circumferential welder is the next stop. Here, tank heads are welded automatically to the shell sections. Turning rolls in a small pit rotate the workpiece under two welding heads, enabling both tank heads to be joined to the shell simultaneously. Two passes are laid on each seam.

Typical welding conditions for a high-tensile steel tank with 3/4-in. walls (size used on service truck tank pictured on this page): current from a constant-potential rectifier welder is 800 amp at 34 volts; wire is 1/4 in. in diameter; welding speed is 15 ipm.

On larger tanks, two shell sections must be joined together on this same girth welder.

When all girth welds have been completed, the tank is moved to another station where nozzles and couplings are installed. The tank undergoes a 400-psi hydrostatic test. A hammer test, with a 10-lb mall, follows.

After the necessary brass work is completed and the dome installed, the tank is moved to the painting booth.

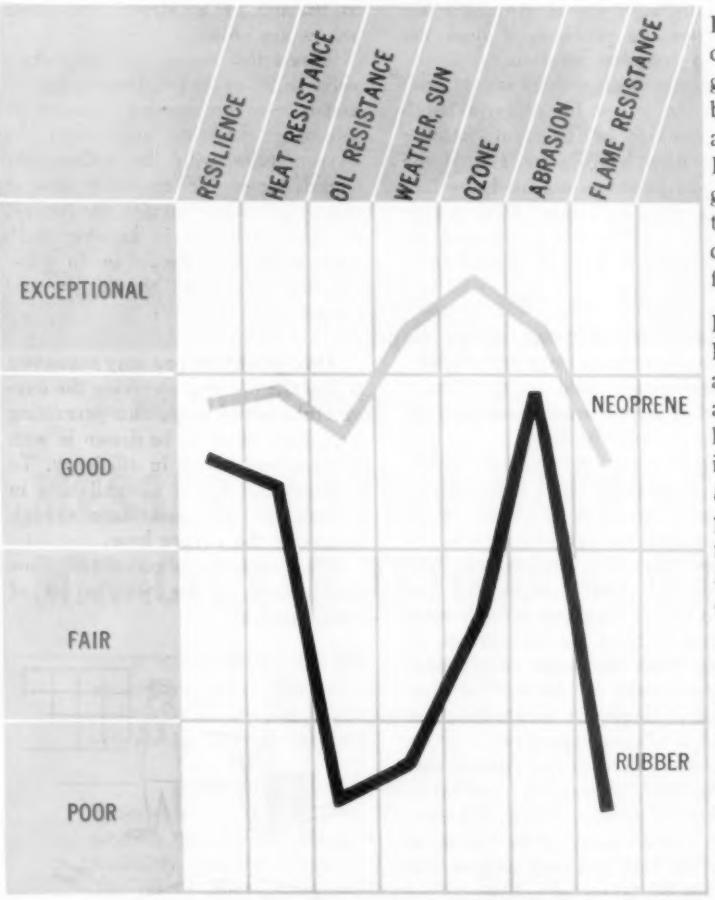
Next stop: the customer.

CLOSE-UP of one of two welding heads on girth welder. Plate here is 3/4 in. high-tensile steel. Vacuum system recovers flux.

FINISHED products, after painting, are stored in yard outside plant prior to shipment. Tanks range from 4-gal to 6,000-gal capacities.

TANK on service truck was built for General Motors for shipment overseas. It will be used to transport liquified petroleum. Truck has right-hand drive.

HERE'S PROOF THAT **PHELPS DODGE HABIRPRENE** (NEOPRENE) **ARC WELDING CABLE** IS STRONGER, LASTS LONGER!



(Adapted from chart of Elastomer Chemical Dept., E. I. du Pont de Nemours & Co., Inc.)

Phelps Dodge Habirprene arc welding cable combines maximum flexibility with the greatest resistance to deterioration caused by exposure to harmful physical, chemical and mechanical conditions. The ability of Habirprene welding cable to withstand greater overall wear and tear, as compared to rubber welding cable, is shown in this chart compiled from comparison tables of four rubber goods manufacturers.

Phelps Dodge pioneered the fabrication of Habirprene welding cable, the first real advance in this field, more than 10 years ago. Records show that Habirprene cable lasts much longer than rubber cable and—in some applications—as much as *four times longer!* Although the initial cost of Habirprene is slightly higher, it will more than repay you in long-time service. Habirprene arc welding cable meets full requirements of A. S. T. M. D752.

See your authorized Phelps Dodge distributor for Habirprene arc welding cable with the indelible gold markings—the sign of higher quality, longer-lasting cable.

Phelps Dodge also makes a full line of rubber arc welding cable and welding power supply cable. All the above cables are available from stock.

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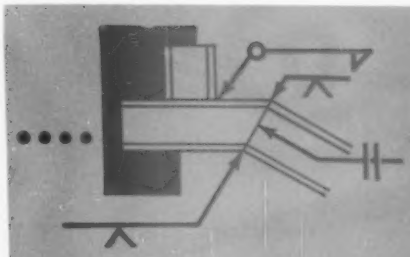


the welding clinic

Here you may find the solution to your welding problems, whether they concern design, production, construction or maintenance welding. Submit your questions for answering on this page.

Copper precipitation and a job shop tip

Question:

Can you give me some information on the presence of copper precipitation or eutectic in 2024 Alclad aluminum?

Answer:

During solidification of 2024 alloy, eight phases are formed by eutectic and peritectic reactions. These phases have been identified as Al solid solutions, Al(Mn,Fe)Si, $FeAl_3$, Mg_2Si, $CuAl_2$, $MnAl_6$, Al_2CuMg and Al_7Cu_2Fe.

A eutectic mixture of Al, $CuAl_2$, Al_2CuMg and Mg_2Si forms as a final solidification product at about 930 F. In solution-treated sheet material, state welding and metallurgical experts of Kaiser Aluminum & Chemical Corp., these phases will usually be randomly dispersed throughout the material.

When 2024 is welded, material adjacent to the line of fusion becomes heated to a temperature at which recrystallization can occur. Above 950 F—even during the fairly short heating span associated with automatic Tig or Mig welding—the low-melting eutectics will not only melt but will also tend to segregate at grain boundaries.

This brittle network results in very low transverse ductility, poor fatigue performance and cracking. Cracking may occur during welding itself or later, when the unit is under static or fatigue stresses. A few mils thickness of pure aluminum cladding has no effect on this phenomenon.

The aircraft industry has attempted to reduce eutectic melting in the weld-heat zone in alloys like 2024 by lowering net heat input to the weldment. One method employs two Tig torches—one to preheat and partially fuse; the other to weld at abnormally high speeds. Although this mitigates the problem, it does not offer a complete solution.

Materials such as 2024 should preferably be joined by adhesive bonding, riveting or by spot welding rather than by Mig or Tig. If the inert-gas processes *are* used, the fabricator must be aware of the design and service limitations imposed by low ductility in the heat-affected zone.

♦ ♦ ♦

Nearly every year automobile compression ratios increase slightly. As these ratios build up, the danger of carbon deposits decreasing engine efficiency rises with them.

Start-and-stop driving in heavy traffic encourages rapid formation of carbon in compression chambers, on pistons and on cylinder heads. To remove this offending carbon, mechanics will usually recommend one of two things: running at high rates of speed to burn out the carbon, or tearing down the engine and cleaning the works by hand. The first method is frequently impossible; the second is always expensive.

But any job shop can remove carbon quickly, thoroughly, and at a fraction of garage prices. The simplicity and economy of the operation lies in the fact that pure oxygen will burn off the layers of carbon.

First step in the process is to remove all wiring and equipment likely to be harmed by heat. Turn off gasoline flow and drain the carburetor. Be sure, however, that the cylinders' water jackets are full; otherwise, generated heat might crack the combustion chambers.

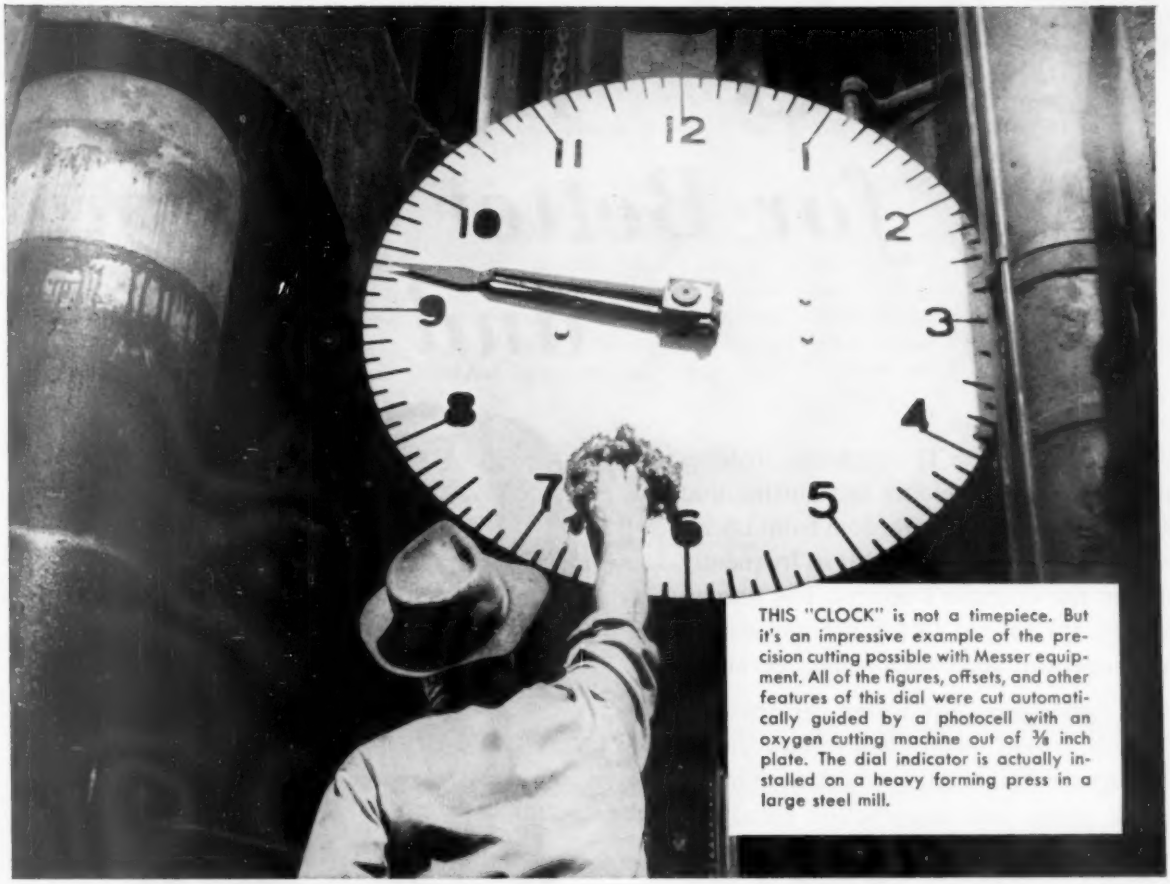
Now unscrew the spark plug from the cylinder to be cleaned. Place the piston in its firing position; that is, at the top of its stroke when both valves are closed.

Adjust the oxygen flow regulating valve to 20 or 30 psi. Drop a lighted match into the opening exposed by removing the plug and insert the oxygen tube with the valve only slightly open (an excessive flow at this point will extinguish the flame). After the carbon is burning well, more oxygen can be fed in. In a few minutes all carbon should be consumed.

One problem you may encounter is that the opening receiving the oxygen tube is too large, thus permitting a quantity of air to be drawn in with a consequent drop in efficiency. To counteract this, cut a small hole in an asbestos disc just large enough to receive the oxygen hose.

When cleaning is completed, blow out carbon residue with a jet of compressed air.

"The wrought iron trend is sure catching on. This is the 10th rug order we've had in a week!"



THIS "CLOCK" is not a timepiece. But it's an impressive example of the precision cutting possible with Messer equipment. All of the figures, offsets, and other features of this dial were cut automatically guided by a photocell with an oxygen cutting machine out of ⅜ inch plate. The dial indicator is actually installed on a heavy forming press in a large steel mill.

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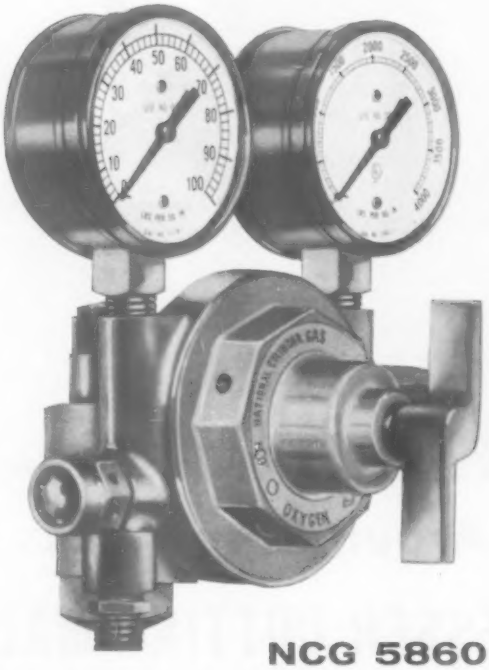
Your nearest NCG dealer or branch office will be glad to arrange a demonstration. Or write today for descriptive literature.



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Two-stage construction. Balanced design using opposing valve characteristics maintains preset gas pressures unvaryingly through all stages of usable pressure. No more varying flames; no more running back and forth to make corrective adjustments. You set it and forget it.

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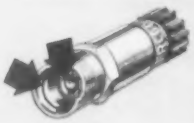
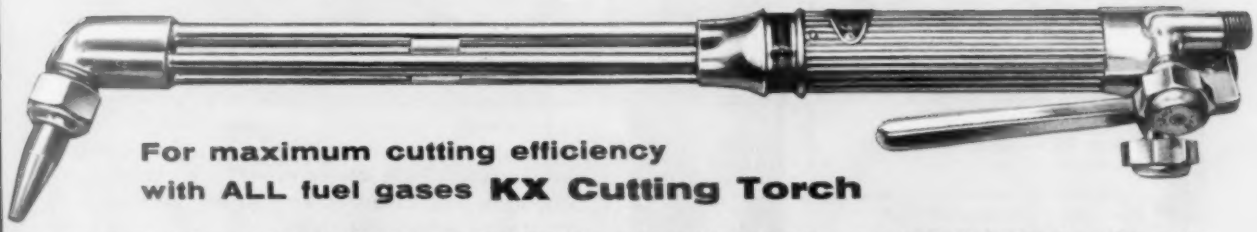
GX handles lightest sheet up to heavy castings. Operates at low pressures producing soft flames. Cylinder residuals reduced to a minimum. With KXA Cutting Attachment will cut steel up to 8" thick.

Leak-proof Joints . . . with Hand Tightening



Neoprene seating rings in the torch head permit positive, leak-proof coupling of mixer and handle with hand tightening alone. Result is longer torch life. No metal-to-metal contact. No strain on threads. Seating rings absorb normal wear and abuse, prevent scratching or scoring of metal seating surfaces.

Big, easy-grip valve wheels permit precision setting. Chrome-plated valve seats, monel valve stems. Non-seizing, non-scoring.



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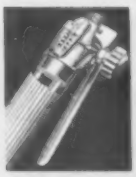
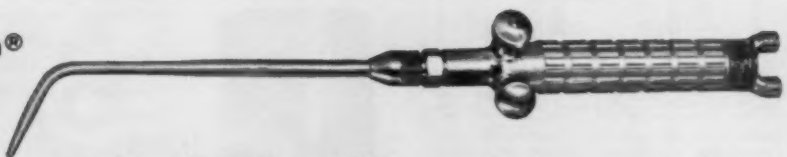


Diaphragm type high pressure valve in forged brass body replaces conventional packing to prevent leaks. Long high pressure lever gives operator precise control of cutting oxygen.

Stainless steel tubes in triangular construction give maximum strength and rigidity. Tubes silver-brazed at head and valve body to provide strong leakproof joints.

Stainless steel head withstands high heat without distorting, eliminates gas leaks that result from warped seating surfaces.

NCG 44 Bantam® Welding Torch for LIGHT welding



The one light welding torch with all the features welders look for. Welds aluminum and alloys, aircraft tubing and steel from 28 gauge to ⅜" thick. It's light, easy handling, compact—*gets into an absolute minimum of space*. Valve wheels are right under your thumb for quick adjustment. Stainless steel stems are non-seizing and non-scoring. Nickel alloy tubes are silver brazed for added strength. Uses swaged-style Series NCG-71 Tips or screw-in style Series NCG-170 Tips. Length, less tip—6½".

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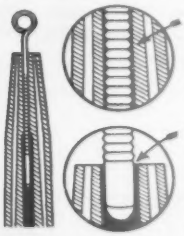

These rounded outer edges of cleaning ridges clean and polish tip orifice without scratching or cutting.

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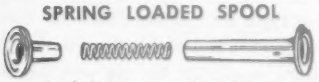

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28	48-47
30	46-45
32	44-43
34	42-41
37	40-39-38
29	37-36
42	35-34-33
44	32-31
45	30

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17	57
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24	53-52
26	51-50-49
28	48-47
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32	44-43
34	42-41
37	40-39-38
29	37-36
42	35-34-33
44	32-31
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Five, four, three, two, one . . .

A new missile steel offers high strength and toughness

MISSILES AND ROCKETS of the future will streak through the atmosphere with new strength and durability—thanks to a high-strength alloy sheet steel produced by U. S. Steel Corp.

The new steel (developed by the corporation's research center in Monroeville, Pa., and called Airsteel X-200) is the result of two years of research. The attained goal: a sheet steel able to overcome the many welding and fabricating problems in missile manufacturing and, at the same time, to possess desired strength and toughness levels.

One of its most unique characteristics is a tensile strength of up to 280,000 psi when air cooled and tempered. Most other alloy steels require elaborate oil or salt quenching to attain equivalent mechanical properties.

Oil or salt quenching has many disadvantages, *e.g.*, huge quenching tanks are necessary to accommodate large missile components. In some cases, strength levels may vary in missile parts due to uneven quenching action and when uneven stresses exert twisting or warping action, extensive straightening methods are required to correct distortion.

In general, the new steel gets its high strength from a careful balance of alloying elements which have been proved suitable for making steel air-hardenable.

Fabrication tests conducted on various missile components included forming, weld fit-up, welding, heat-treatment and hydrospinning. (Production of the steel in a "soft" or annealed condition allows easy forming, cutting or shaping.)

The weldability study, which included evaluation of metal-arc and inert-gas welding, showed that welded joints equalled the steel in strength.

After forming and welding in the annealed condition, a typical missile component made of the new steel was heated to an established temperature and allowed to air cool to room temperature. The air-hardened steel then received a tempering treatment at a lower temperature, followed by air-cooling again. Ductility and toughness were excellent.

The new steel is available for uses other than on missiles, and it comes in billet, bloom, bar, plate and sheet forms.

IN a fabrication and weldability test, the new high-strength steel was shaped into a ¼-in.-thick welded cylinder blank (bottom) and hydrospun to produce a 0.080-in.-thick cylinder (center). The longitudinal weld is shown in both.

STOODY 1030

A new, low-cost hard-facing electrode that excels in *POSITION* WELDING!

Here's a new Stoody hard-facing rod especially made to fulfill several "musts"! *Stoody 1030 is unusual in its all-position weldability!* This means easier, faster hard-facing on much larger equipment...equipment which has to be hard-faced in the yard or on the job...equipment which can't be positioned to facilitate a down-hand welding setup!

TOP WEAR RESISTANCE within its price class! Stoody 1030 fits between Stoody Self-Hardening and Stoody 21 in wear qualities, favoring the latter. It satisfies all requirements where good abrasion resistance is essential, at the same time saves several cents per pound.

EXCELLENT COMPRESSIVE STRENGTH adapts Stoody 1030 to such applications as roll crushers; also sides, lips and teeth of power shovel buckets; drag lines and clamshells; carrying scraper blades, runners, etc.

APPLICATION—Either AC or DC, with a choice of straight or reverse polarity on DC. 3/16" rods weld at 140-220 amps, 5/16" rods at 225-275 amps. Straight polarity induces very fast burn-off and minimum penetration. Deposits set up rapidly, easily holding edges of welds. Spatter is negligible; overall application efficiency is approximately 78%. No slag covering results, makes easy multiple passes. Complete size range from 5/32" to 5/16".

Try Stoody 1030 on your next job – test its position welding advantages and wear resistance...make extra savings with its low cost!

Literature on Stoody 1030 is available from your Stoody Dealer (check the Yellow Pages of your phone book) or write direct.

STOODY COMPANY

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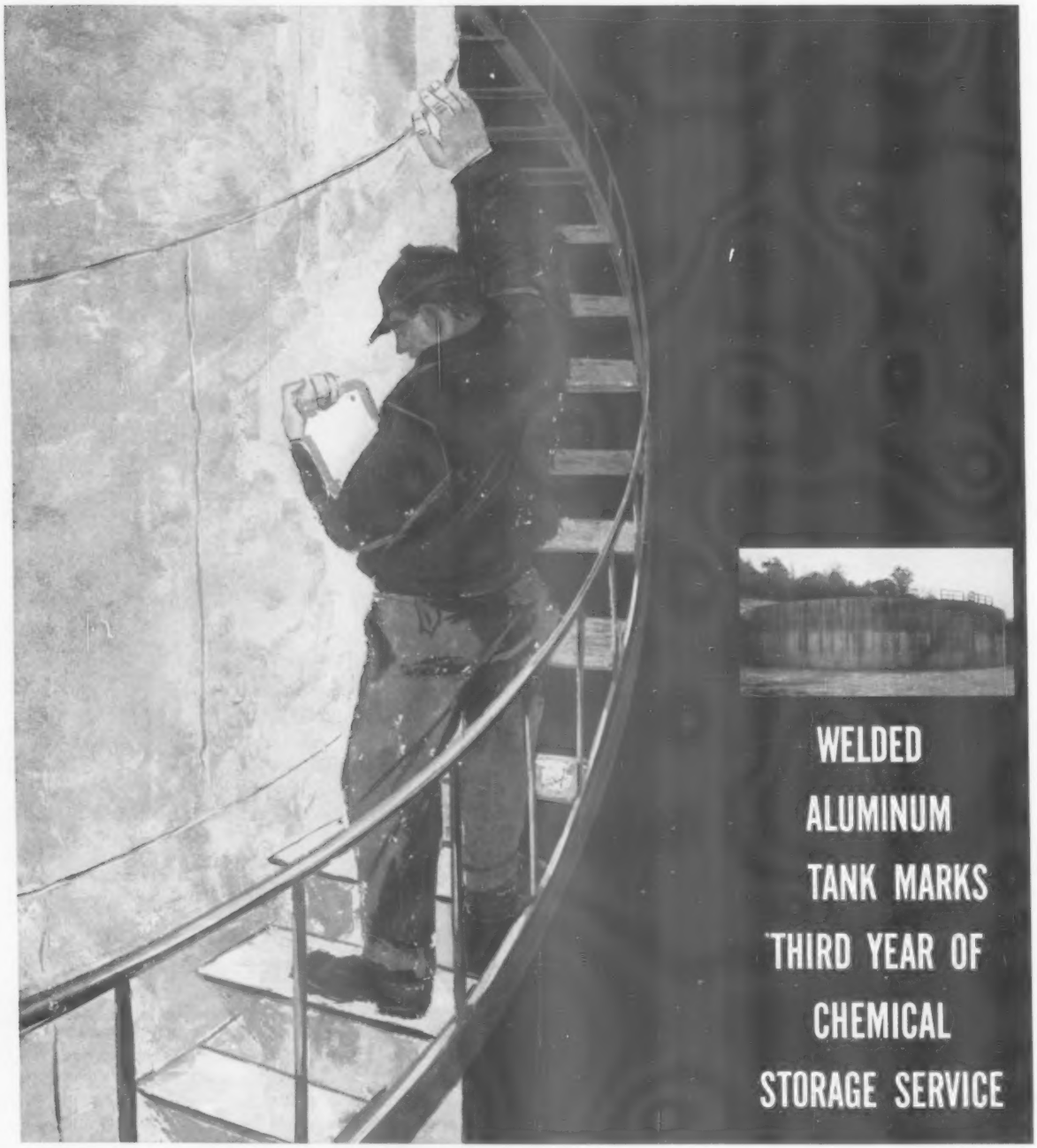
Whittier, California



WELDED ALUMINUM TANK MARKS THIRD YEAR OF CHEMICAL STORAGE SERVICE

Mississippi River Chemical Company's all-aluminum welded tank is doing the job expected when it was built three years ago—providing trouble-free chemical storage with a minimum of maintenance.

The world's largest welded aluminum tank, it stretches 128 feet in width and rises 26 feet in height. After more than three years of constant exposure to 2⅓ million gallons of highly corrosive ammonium nitrate, its Alcoa® Aluminum plates and weldments remain virtually unaffected, ready for longer service.

The giant tank was field erected by the Chicago Bridge and Iron Company. Welds were made with Alcoa welding alloy 5052 by the inert-gas, metal arc-welding process. The bottom plates are 1⅞ inches thick and courses taper to ⅜ inch at the top.

Alcoa, besides supplying the aluminum for this gigantic undertaking, rendered valuable help and guidance before and during construction. You can get the same help in welding, brazing or soldering aluminum by calling one of the Alcoa Distributors listed here. For FREE informative books and for free loan of films on joining aluminum, write: Aluminum Company of America, 1740-K Alcoa Building, Pittsburgh 19, Pa.

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Your Guide to the Best in Aluminum Value

Want technical help in welding, brazing or soldering aluminum? Contact your Alcoa sales office, listed under "Aluminum" in the Yellow Pages of your phone book.

For immediate delivery of Alcoa welding products, call your Alcoa outlet listed below. He carries a complete range of alloys and sizes.

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CLEVELAND, site of the 40th National Metal Exposition and Congress, Oct. 27-31.

Welding exhibits, papers on agenda

Cleveland to house 40th Metals Show

"MAKE IT BETTER with metals . . . for less" is the theme of the American Society for Metals 40th National Metals Exposition and Congress to be held Oct. 27-31 in Cleveland.

The expected 50,000 visitors will see 500 exhibits at Cleveland's Public Auditorium, and will hear 150 technical papers. Several welding equipment manufacturers will exhibit their products, and many papers will be of specific interest to the welding industry.

Two papers on fabricating molybdenum will be given at the Hotel Cleveland. "Fusion welding molybdenum" will be presented by D. C. Martin, Battelle Memorial Institute, Columbus, Ohio, and "Brazing molybdenum" will be presented by G. S. Hoppin III, General Electric Co., Cincinnati.

High pressure applications of metals will be discussed by R. E. Lorentz, W. B. Bunn and C. T. Ward, Combustion Engineering Inc., Chattanooga, Tenn., in their paper "New welding techniques in pressure vessels." "Heat treatment of weldments" will be given by Norman Block, Foster Wheeler Corp., New York City. These are also scheduled for the Hotel Cleveland.

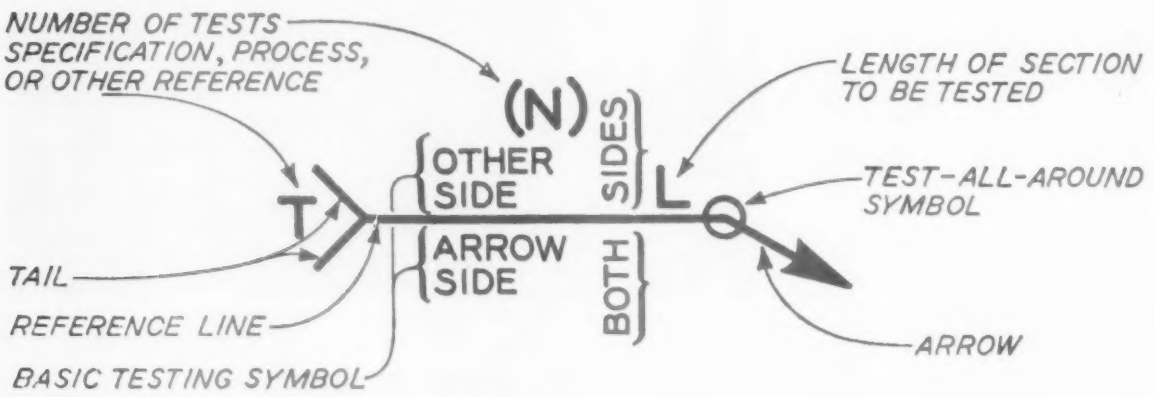
The Society for Nondestructive Testing will meet at Hotel Manger during the show and present 50 technical papers. The Tuesday, Oct. 28 session will deal with weld evaluation. The following papers will be given: "Ultrasonic weld inspection," by John E. Bobbin, Sperry Prod. Inc., Danbury, Conn.; "Investigation of radioisotopes for the inspection of ship welds," by a representative from Naval Ordnance Lab., White Oaks, Md.; "Radiographic inspection of welded turbine wheels for jet starters," by A. R. Potenski, Bendix Aviation Corp., Utica, N. Y.; "Nondestructive testing assists the small manufacturer," by A. G. Barrow, Marquette University, Milwaukee, and S. J. Boehringer, Boehringer Engineering Prod. Inc., Milwaukee; and "Radiographic inspection of welded highway bridges," by J. L. Beaton and Paul G. Jonas, California Div. of Highways, Sacramento.

Six other groups will cooperate with ASM by presenting sessions during the show.

Dr. Clarence O. Lorig, technical director for Battelle Memorial Institute, will be named to succeed G. MacDonald Young, technical director of Aluminum Co. of Canada Ltd., Montreal, as president of ASM. Lorig will take office following the show.

Dr. Peter Payson, Crucible Steel Co. of America, Pittsburgh, will lecture on "Tempered alloy martensites" in the Campbell Memorial Lecture Series. The series, named after the late Edward deMille Campbell, began in 1926. Campbell was a university chemical engineering professor who did much of his work after being blinded by a laboratory explosion.

Out of the planning stage and on to plans . . .



A key to non-destructive test symbols

A FEW MONTHS AGO, twenty-seven men gathered about a conference table in the heart of New York City.

They represented the welding industry, research institutions, communications, steel suppliers, automobile manufacturers, the government; they were, in fact, a cross-section of American industry.

Who were they and why were they meeting? These men were all members of the American Welding Society's Committee on Nomenclature, Definitions and Symbols. They were in New York to create standard symbols for non-destructive testing.

Consider the problems they faced . . . there are four basic nondestructive testing methods: radiographic, magnetic particle, penetrant, and ultrasonic. From these groups, a welding engineer may choose one of a number of techniques for testing welds without destroying them.

But how does he inform his foreman which he wants and where he wants it used?

Until the committee met, each welding engineer had his private shorthand, which could be deciphered, perhaps, by one foreman but not by another. Now, plans for a weldment can be shipped a thousand miles—into an entirely different industry—and quality control personnel will read it as easily as weldors read welding symbols.

The drafters of the symbols began their task by abbreviating the common tests. *RT*, they decided, would indicate radiographic testing. *MT*, magnetic particle. *PT*, penetrant testing. *UT*, ultrasonic testing.

The basic symbol for weld placement—the arrow—is integrated into the new system as well. The composite testing symbol shown here clearly outlines the overall structure of the plan.

It includes, besides the reference line and arrow, the basic testing symbol; the number (N) of tests; a tail for notations; extent of tests; process, etc. Simple—but all inclusive.

The committee explains (in the booklet, *Nondestructive Testing Symbols* AWS A2.2-58) that the arrow connects the reference line to the part to be tested. That side of the part to which the arrow points is termed the "arrow side"; the side opposite the arrow is, of course, the "other side."

When tests are to be made on the arrow side of a part, this is indicated by placing the testing symbol on the side of the reference line closest to the reader (Fig. 1). Tests to be made on the other side of a part are indicated when the testing symbol appears on the side of the reference line farthest from the reader (Fig. 2).

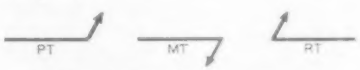


FIG. 1 Test-this-side symbol.

FIG. 2 Test-other-side symbol.

Placement of the test symbols on both sides of the reference line calls for testing both sides of the part (Fig. 3). The fourth manner in which testing symbols may be placed —centered on the reference line—is used whenever there is to be no distinction between arrow- and other-side (Fig. 4). This is often used in conjunction with a test-all-around symbol.

FIG. 3 Test-both-sides symbol.

FIG. 4 No distinction between sides to be tested, plus test-all-around symbol.

If radiographic testing is to be done and specifications call for exact location of radiation source and direction of radiation, this information is included with the testing symbol as shown in Fig. 5.

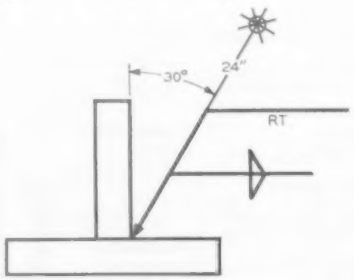


FIG. 5 Source and direction of radiation.

R. W. Creamer, V.P., checks x-ray films of tank welds.

Picture of a man saving $400 per unit

It's done with Kodak Industrial X-ray Film, Type AA

Creamer and Dunlap, Inc., make pressure vessels—big ones, 67 ft. long by 9 ft. in diameter. Because they radiograph every inch of every weld to determine soundness, they can use thinner plate. This results in about 10% less weight with attendant savings in fabrication, handling and shipping. Altogether it adds up to as much as $400 per unit.

What's more, radiography helps to assure customers of a high-quality, safe product.

This company switched to Kodak Industrial X-ray Film, Type AA, because, "This film," they say, "is faster and has superior contrast, definition and radiographic sensitivity."

Your x-ray dealer and the Kodak Technical Representative will gladly tell you how Kodak film can improve your radiographic operation and help you get more out of your present x-ray or gamma-ray equipment. It can pay you to get in touch with them.

Read what Kodak Industrial X-ray Film, Type AA, does for you:

- Speeds up radiographic examinations.
- Gives high subject contrast, increased detail and easy readability at all energy ranges.
- Provides excellent uniformity.
- Reduces the possibility of pressure desensitization under shop conditions.

EASTMAN KODAK COMPANY, *X-ray Division*, Rochester 4, N.Y.

For inspection of welds, Kodak Industrial X-ray Film, Types AA, M, and KK, are available in the 70mm by 550 ft. package, as well as in standard sheet sizes.

Kodak
TRADE MARK

AWS test symbols . . .

Welding symbols and testing symbols can be combined as in Fig. 6.

FIG. 6 Welding and testing symbols combined.

Combinations of testing symbols are shown in Fig. 6a.

FIG. 6a Combination of testing symbols.

To specify length of section to be tested, the measurement is marked in inches to the right of the test symbol (Fig. 7).

FIG. 7 Length-of-test-section symbol.

A variation of this, which shows the exact test location and its length, calls for the use of dimension lines drawn like those in Fig. 8.

FIG. 8 Exact-test-length symbol.

When a part's full length is to be examined, no dimensions need be shown. Or, if tests are to be made at random, the number of desired tests are written in parenthesis as illustrated in Fig. 9.

FIG. 9 Number of tests desired.

There are two further methods for indicating areas to be tested—one for planes and one for areas of revolution. Plane areas on a drawing should be enclosed within straight, broken lines with a circle at each change of direction. Testing symbols will then refer to this area. When necessary, dimensions of the area are also included. (Fig. 10.)

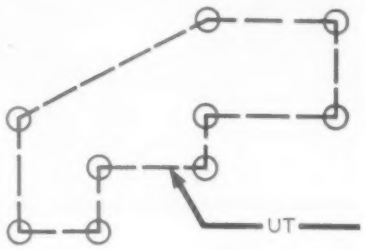


FIG. 10 Symbols on plane surface.

Areas of revolution are easily recognized, if the engineer uses the test-all-around symbol on his reference line. (Fig. 11.)

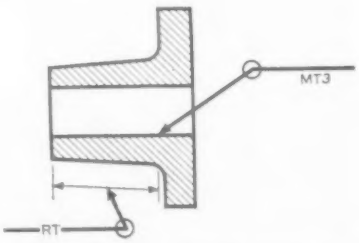


FIG. 11 Symbols on area of revolution.

This on-the-job test reports:

"Cooler . . . lasts 3 times as long"

Spot Welder No. 89 | Service Welder No. 199 | Welder's Mitten No. 98

Riegel

WELDER'S GLOVES

"The Riegel No. 99 Heavy Welder lasts six weeks against two weeks for the glove we used formerly. The men tell us it's more comfortable and cooler."

So reports Mr. Richard Thornell, whose switch to Riegel now saves $35.00 yearly per man at Oliver Corporation, Springfield, Ohio.

No. 99 facts: Heavy but flexible "flextan" welders' leather, gunn cut, wing thumb. Extra roomy, extra long. One-piece back, wool-insulated . . . all exposed seams welted . . . full protection against heat and sparks.

Riegel has the service you want, too . . . industrial specialists to help select the right style . . . eight warehouses to speed delivery. Write or phone today.

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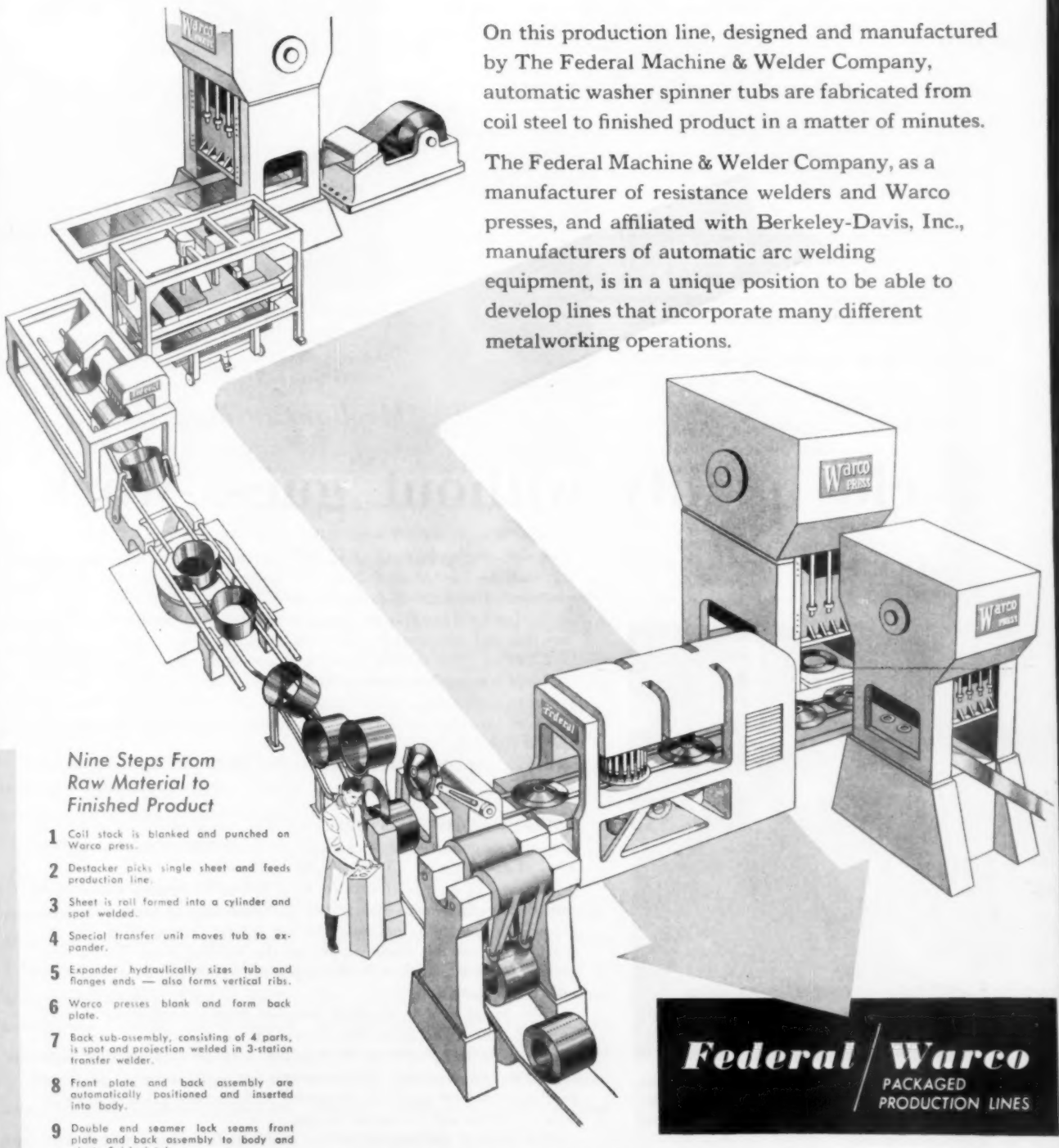
THE ACCENT IS ON PRODUCTION

in a production line by FEDERAL

On this production line, designed and manufactured by The Federal Machine & Welder Company, automatic washer spinner tubs are fabricated from coil steel to finished product in a matter of minutes.

The Federal Machine & Welder Company, as a manufacturer of resistance welders and Warco presses, and affiliated with Berkeley-Davis, Inc., manufacturers of automatic arc welding equipment, is in a unique position to be able to develop lines that incorporate many different metalworking operations.



Nine Steps From Raw Material to Finished Product

1. Coil stock is blanked and punched on Warco press.
2. Destacker picks single sheet and feeds production line.
3. Sheet is roll formed into a cylinder and spot welded.
4. Special transfer unit moves tub to expander.
5. Expander hydraulically sizes tub and flanges ends — also forms vertical ribs.
6. Warco presses blank and form back plate.
7. Back sub-assembly, consisting of 4 parts, is spot and projection welded in 3-station transfer welder.
8. Front plate and back assembly are automatically positioned and inserted into body.
9. Double end seamer lock seams front plate and back assembly to body and ejects finished tub.

* Sequence of operations controlled by static relay system designed and built by Federal.

Federal / Warco
PACKAGED PRODUCTION LINES

THE FEDERAL MACHINE AND WELDER COMPANY, WARREN, OHIO
Affiliated with Berkeley-Davis, Inc., Danville, Illinois

A PLANT TOUR conducted during the 1958 American Welding Society convention in St. Louis brought to light the high degree of mechanization employed by Midwest Piping Co., Inc., in the manufacture of welded pipe fittings.

But the machine efficiency which visitors witnessed was once unknown to industry. Before the introduction of automatic welding equipment at Midwest, for instance, highly-skilled manual weldors provided the basis for the St. Louis firm's good reputation.

When powered positioning equipment and the automatic submerged-arc process came on the scene, however, Midwest Piping saw tangible proof of the manner in which machines could take the guesswork out of weld quality on the production line.

But how does a plant producing a multiplicity of product styles and sizes achieve any thorough form of automation?

This problem stumped plant management until logical deduction led them to realize that certain important factors were common to the fabrication of most of its products. These similar factors were studied, and a program was initiated to automate as many processes as possible.

Specialists were consulted on welding processes, positioneering and material handling.

Flow patterns and relaxation methods were studied.

Midwest's research and sales engineers were queried regarding trends in product and market development.

From these actions emerged a plan for mechanization. The implementation of a part of this plan is graphically portrayed in the photos accompanying this article. These new installations have justified the firm's faith in mechanization as a quality control tool.

INTEGRATED welding station with steel frame, positioner, beam for carriage travel, welding unit and fixtures holding elbow.

Mechanization permits . . .

Weld quality without guess-work

by **Ned Nyberg**
Welding Consultant

PORTION of production line shows welder tacking elbows *(left)* and elbows being fed to welder *(right)*. Note flux hoppers, hoists and light fixtures suspended from service balcony.

A well-arranged group of 12 fully automatic submerged-arc welding stations has resulted from the design of an overhead service platform. This balcony performs these important functions:

1—It provides a flux storage area and holds the units which regulate flux and filler metal feed to welding stations.

2—It supplies cooling water and operating air to each station.

3—It carries bus ducts with terminal outlets to supply electric power to each welder, and to hoists.

4—It provides auxiliary power outlets and supports fixtures for special lighting.

5—It supports a battery of electric hoists for handling heavy fittings.

Flux hoppers on the balcony are filled by an attendant stationed atop the structure. Flux is carried to a small hopper on the welding head of each unit by a large, flexible rubber hose.

Delivery of flux is controlled by a solenoid-operated valve built into the welding head. The supply of flux from the balcony can be closed off when it is necessary to use special fluxes, which can be fed locally into the small hopper on the welding head. Excess flux and slag falls into shallow recovery pans and is sent to a flux recovery unit for reclamation.

Filler metal wire is normally supplied from pay-off-packs located on the balcony. Fed from these insulated, automatically rotated containers, wire is brought to the welding head through flexible, nonconductive plastic tubes. Extra mounts for coils and reels of those wire types not yet available in pay-off-packs permit quick changes of filler metal for use on special alloys.

This vertical delivery of service and supply items, coupled with

Low Temperature EUTECTIC WELDING ALLOYS

Plant, Research Laboratory and World Headquarters

HISTORY OF "EUTECTIC LOW TEMPERATURE WELDING ALLOYS"®

Surface alloying at low heat was first discovered by "Eutectic" in 1904 – used today in over 100,000 plants. "Eutectic" is the originator and sole manufacturer of "Eutectic Low Temperature Welding Alloys" for bonding metals at low heat, minimizing distortion, warping and stress.

EUTECTIC Welding News

PUBLISHED BY EUTECTIC WELDING ALLOYS CORPORATION, 40-40 172 STREET, FLUSHING 58, NEW YORK, N. Y.

ANOTHER "IMPOSSIBLE" $5,000 SAVING WITH A "EUTECTIC" WELD

The crack in this early model diesel engine cylinder block posed a major repair problem. Due to the age of the engine, a new cylinder block was absolutely unobtainable. Engineers were faced with the tricky problem of casting an entire new cylinder block from an original pattern, then machining. The cost—$5000. Downtime?—Many weeks.

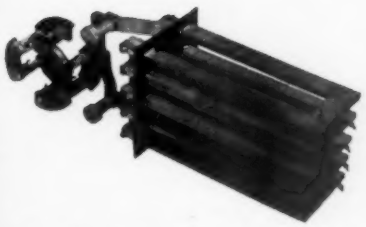
Welding had been considered and tests were made but conventional high heat welding materials produced cracks, "leakers" and stress formations.

The local "Eutectic" Technical Representative was called in, examined the block and recommended welding with Eutectic's Xyron 2-25. This is the newest and most advanced cast iron electrode for overlays and difficult repairs on heavy sections of gray and alloy cast iron. Non-cracking Xyron 2-25 produces dense, smooth, crack-free deposits without preheat. The deposit made is high nickel alloy specially balanced to prevent porosity and cracking. Ultimate tensile strength is 56,000 psi.

Xyron 2-25 has had widespread successful application in the repair of machine bases, cracked motor blocks, motor and gear housings, transmission cases, gears, cams and building-up of teeth in cast gears. It is extremely valuable in permitting welds without fusion or distortion of the base metal.

Weldors repaired this casting with Xyron 2-25 in 78 hours, including all machining and assembly.

Now, after more than six months of continual operation, no pressure leaks or defects of any kind can be found in the weld. The saving of $5000. and many weeks of non-operation, again points up the tremendous savings that are accomplished in over 100,000 plants by the utilization of Eutectic's "Low Temperature Welding Alloys."®



Low Melting...High Conductivity 1801 Bonds 33 Intricate Joints

The 33 joints on this magnet charger used to test precision instruments must have excellent electrical conductivity, a requirement met by joining with EutecRod 1801.

This is a thin-flowing, high silver content alloy with medium plastic range. It is one of the lowest melting of all silver-bearing alloys, but is also one of the strongest, with an ultimate joint tensile strength to 90,000 psi. Deposits closely color matched to many copper alloys. Joints are ductile and leakproof offering exceptionally good corrosion resistance and electrical conducting properties.

In the manufacturer's own words, "...experience dictates use of EutecRod 1801...because its high joint conductivity permits low resistance connections, its strength assures good connections. Its low bonding temperature means simplicity, ease of application, and eliminates distortion, and its fast flow minimizes oxidation."

Xyron 2-25, available in 1/8", 5/32", 3/16" dia. Lt. Blue Tip, secondary — Silver. Standard weight shipments. • **EutecRod 1801** in 1/64", 1/32", 3/64", 1/16", 3/32", 1/8", 3/16" dia. Strips of .020 x 3/32"—.025 x 1/8"—.010 x 1"—.005 x 1"—.005 x 1/2"—.003 x 1"

FREE!
180 PAGE WELDING DATA BOOK
Invaluable procedures and theory of welding practice on all metals.

Eutectic Welding Alloys Corporation
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EUTECTIC 'LOW TEMPERATURE WELDING ALLOYS'® FORMULATED FOR 'LOW HEAT INPUT' BONDING OF ALL METALS INCREASE SAVINGS BY SALVAGE AND REPAIR, SOLVE PRODUCTION PROBLEMS

modular construction of each welding station, permits a close-knit, compact production line to function in minimum floor space.

Each welding station is an integral unit which can be disconnected from service and supply lines and moved as desired to another location in the plant or to the maintenance shops for major service. This quick replacement permits Midwest to schedule capacity production without allowances for delays caused by major breakdowns.

Each of the 12 units is integrated by a heavy steel frame which aligns and supports component mechanisms. A box-section beam, which serves as a track for the travel carriage, is a structural member of the frame. The travel carriage, of course, carries the welding head.

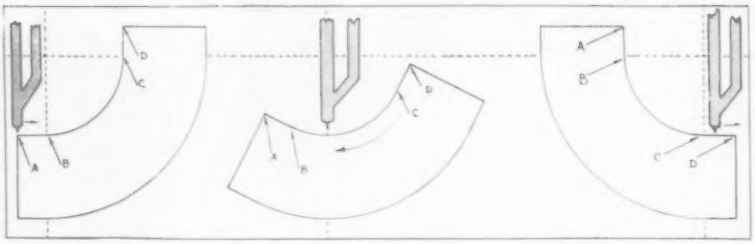
Fittings to be welded are clamped in air-operated fixtures fitted with water-cooled backup mandrels. The latter minimize effects of residual interpass heat buildup.

Fixtures are rotated by standard headstock positioners placed between legs of the frame and resting on its base. Modified with a rapid reversing feature designed to fill Midwest's requirements, these positioners provide rotation in either direction at infinitely variable speeds of zero to 1.35 rpm. This latter feature was deemed necessary to permit maintenance of welding speeds at radii of 3 in. to the 40 in. permitted by the geometry of the basic frame and beam.

A rotational torque of 30,000 lb/in. at maximum speed (more at lower speeds) handles fittings of all wall thicknesses, including schedule 160. Provision has been made to turn even greater loads if necessary.

The main spindle shaft of the headstock extends 6 in. from the back of the frame, and is ready to receive any needed counterweight. This design feature anticipates the large and thick-walled, high-alloy nuclear system components which are welded while filled with water to control highly critical interpass temperatures.

The rapid reversing feature was designed to adapt the positioners for production that is confined almost entirely to one quadrant—particularly on elbows. This modification permits rotation of a load in the direction opposite to that used for welding at the comparatively fast rate of over 1 rpm. An elbow on which one pass has been made can be returned through a 90-deg arc for a second pass in just 15 seconds.



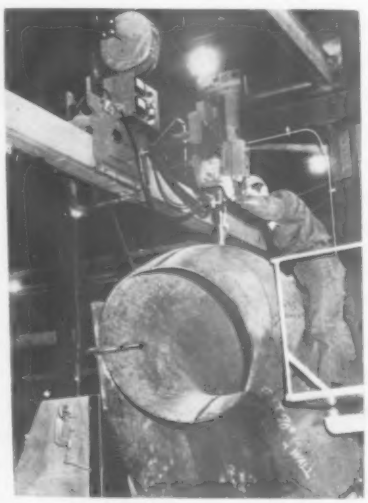
TYPICAL long-tangent elbow has a straight-tangent section on each end that is slightly over one-fourth of pipe diameter in length. Section can't be welded automatically while fixture is rotating under welding head, so Midwest handles job this way: *(1)* Arc point is at "A" with left tangent horizontal; *(2)* Welder is started and carriage moves head to right toward "B" at welding speed; *(3)* At "B," carriage stops and positioner rotation begins; *(4)* Arc reaches "C," right tangent is horizontal, positioner rotation stops and carriage travel resumes to right to complete weld; *(5)* Point "D" is reached, welding head is retracted, rapid reverse unit is engaged, and fitting is returned to start position for second pass. Return travel time is used to clean slag from weld, wire-brush it and inspect it visually.

This feature, made possible by an additional constant-speed drive system operated through an arrangement of electric clutches and interlocking relays, obviously increases arc time. It also eliminates a temptation to weld back and forth in both directions.

Welding of huge fittings also has been mechanized at Midwest Piping. Actually, production runs of these out-size "specials"—which may range from 24 to 42 in. in diameter—have become routine since adequate facilities were installed.

On this page is a photo of a 36-in.-diameter long-tangent elbow clamped to a large headstock for submerged-arc welding. Welding head and carriage are mounted on a fixed-beam manipulator with powered elevation control.

The headstock used in this instance develops 400,000 lb/in. of rotational torque at maximum speed. Minimum speed goes to zero, an essential design factor for welding at large radii. The rapid reversing mechanism is also a feature of this headstock, and it returns the elbow through a 90-deg arc in 30 seconds.



POSITIONER rotates huge long-tangent elbow under welding head as operator checks flux feed and arc length. Welding unit is mounted on fixed-beam manipulator.

Although quality control has profited to a great extent from welding mechanization, Midwest Piping's competitive position has benefited in other respects, too.

¶ Delivery of fittings can be scheduled with less fear of production failures.

¶ Cost of quality production can be more accurately predicted.

¶ Customer acceptance of, and confidence in, the firm's welded products is merited to an even higher degree than before.

¶ Reductions in production costs through automated welding quickly amortize the required capital outlay.

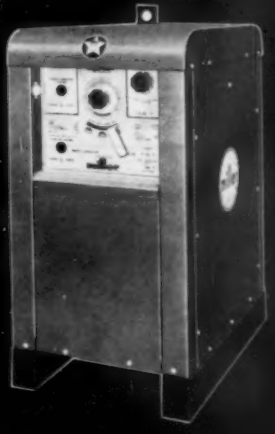
With such strong evidence of the value of welding mechanization, Midwest's management is reviewing many other operations with an eye to similar potential improvements.

SR . . . the dc rectifier type welder with new completely sealed semimetallic rectifier, new transformer and new weld stabilized circuit. Result is easiest arc starting ever; maximum arc stability; sounder, denser welds; current that handles all electrodes in all positions! Four models, 200 to 600 amps.

SRH . . . the same revolutionary improvements that set the Gold Star SR above and beyond the performance standards ever before achieved by a dc rectifier type welder. Designed primarily for compactness, the SRH is only 30¼" high — is ideally suited for stacking or paralleling in minimum space. Three models, 200 to 400 amps.

The miller GOLD STAR ALL STAR LINE

300 . . . combination ac/dc welder design comes of age with this new Miller model. Features: new magnetic amplifier circuit; improved wave form; new arc starting control; three electrically controlled current ranges for finest adjustment; instant change-over from ac to dc; built-in high frequency. An entirely fresh concept for inert gas and metallic welding. Four basic models with kits available to convert to seven different types of welders.



300-M . . . an ac welder for inert gas and metallic arc processes. Combines unequalled welding characteristics with Miller's unique electric control circuit which permits precise slow or fast start. Features: built-in high frequency, primary contactor and ½ KVA control transformer. Offered in three basic models of from 200 to 400 amperes with optional water and gas controls available.

Complete particulars on any of the above welders will be sent promptly.

miller ELECTRIC MANUFACTURING COMPANY, INC. Appleton, Wisconsin

Distributed in Canada by Canadian Liquid Air Co., Ltd., Montreal, P. Q.

Stainless steel

vapor trails

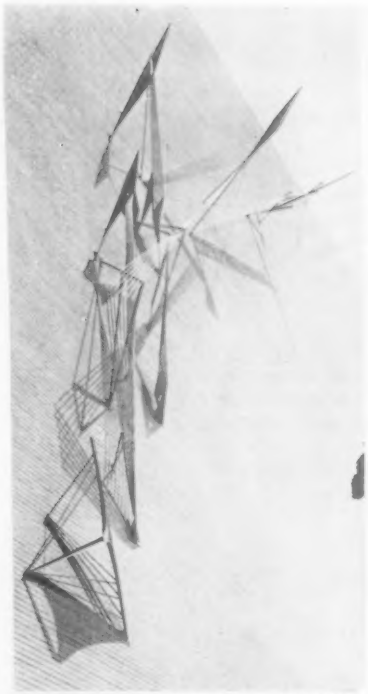
TWO NORMALLY UNRELATED functions—an artist's idea and the Tig welding of stainless steel—were recently combined to produce a representation of jet planes reaching the threshold of outer space.

"Vapor trails," by sculptor Gwen Lux, is the 800-lb, 56-ft creation that adorns one wall of the new Aviation high school in Long Island City, N. Y.

Type 304 stainless steel, weldable and heat resistant and containing 18% chromium and 8% nickel, was used.

Practical and symbolic reasons backed up the choice of stainless steel for this project. Stainless is resistant to the corrosive properties of Long Island City's industrial atmosphere — and it is one of the chief metals used in constructing jet planes.

Criss-crossing vapor trails are symbolized by stainless steel tubes and sheets, as Miss Lux tried to create the impression of jet planes of the future soaring through earth's atmosphere—and beyond.

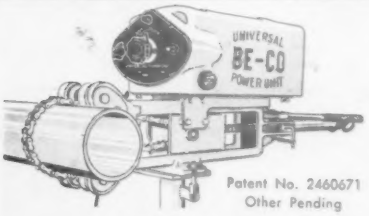


Electromet Div. of Union Carbide Corp.

CLOSE-UP view of "Vapor trails," a non-objective representation of jet planes of the future as they race toward outer space. Creation is 5½ stories high.

AVIATION high school, Long Island City.

WORLD'S MOST VERSATILE POWER UNIT & WELDING POSITIONER FOR FIELD OR SHOP



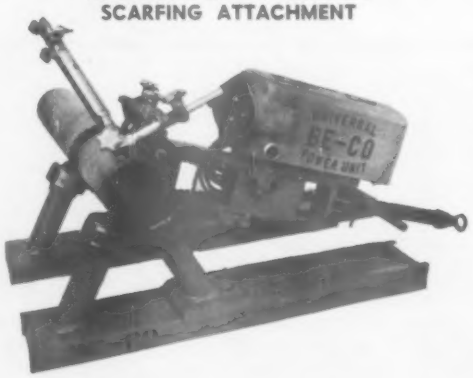
Patent No. 2460671
Other Pending

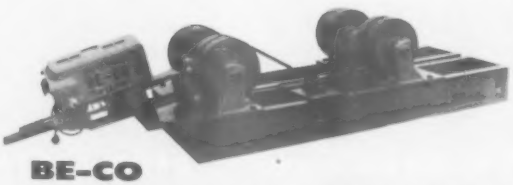
BE-CO
UNIVERSAL POWER UNIT
PORTABLE WELDING POSITIONER
AC or DC CURRENT

BE-CO ENGINEERING CO.

9628 EAST VALLEY BLVD.
ROSEMEAD, CALIFORNIA

BE-CO UNIVERSAL POWER UNIT WITH BALL PIPE ROLLS and PIPE SCARFING ATTACHMENT





BE-CO
PORTABLE CHAIN DRIVE POWER ROLLS
10 TON CAPACITY

SOME OF THE MANY USES

As a positioner for:

Welding	Chipping
Cutting	Threading
Burning	Sandblasting
Fitting	Painting
Grinding	Coating

For pulling overhead and underground

Cable	Tube
Wire	Conduit
Pipe	Inserts

As power source for:
Hoists - Lowerators
Elevators
Conveyor Drives

BE-CO
SPECIAL PATENTED QUICK CONNECTING CHAIN LINKS

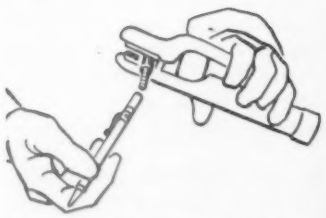
NO ELECTRICAL CONTACT TAKES MORE ABUSE THAN YOUR ELECTRODE HOLDER JAWS

Clean Jaws Save Time and Money

New "Jaw Cleaner"

JAW CORROSION AND DIRT BUILD RESISTANCE

1. Cuts speed of welding by cutting flow of power.
2. Causes arcing between bare end of rod and jaws, pitting jaws and building up heat.
3. Causes heating of rod, splitting of coating and throwing away long stubs.
4. Builds up heat in Holder, resulting in down-time for cooling. **Clean jaws cut holder temperature as much as 50°.**
5. Every welder should carry an ATLAS **"Jaw-Cleaner".**



Insert tapered end of brush to hold jaws open. Pull handle away.

Reverse broach in handle. Clean contact surfaces and sides of jaws.

Now cock jaws open with tapered end of broach and use brush for final polishing.

1. CLEANING BROACH

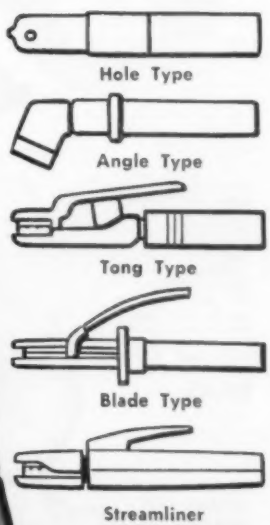
Cleans corrosion, spatter and dirt off Jaws. Does not cut away metal. Double teeth clean in both directions.

2. POLISHING BRUSH

Spiral wire type with long life. Finishes the job with a like-new polish and perfect contact surface.

SUGGESTED LIST PRICES		
1-5	6-23	24-71
$2.50	**$2.25**	**$2.13**
72-143		144-UP
$2.00		**$1.88**

FOR ANY HOLDER



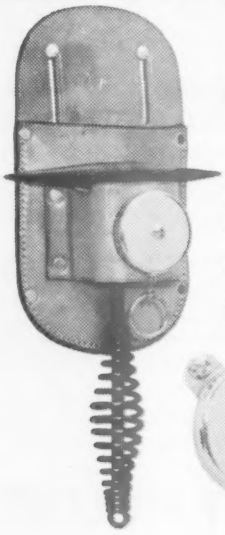
Start getting better holder performance— Clean jaws save money

ATLAS
WELDING ACCESSORIES INCORPORATED
707 E. LEWISTON
FERNDALE 20, MICH.

WELDERS SAVE TIME & MONEY with

KEY-BAK

NEW ITEMS!



11-W

Sturdy leather pouch worn on the belt, holds chipping-hammer; KEY-BAK to hold flint-lighter is firmly attached. Price includes Pouch with KEY-BAK attached $6.95

Special KEY-BAK Model 7 attaches to drill-press and holds special SAF-T-CHUCK KEY. Worker must hold key in to use drill-press; when released it kicks itself out. Key cannot be thrown to harm worker. Price includes KEY-BAK and SAF-T-CHUCK KEY $4.45

OVER A MILLION KEY-BAKS HAVE BEEN SOLD!

NUMBER 5 KEY-BAK . . . Pocket-watch size; chrome finish. Swedish clock spring reels in 24" long stainless-steel chain. Keeps lighter, keys etc., always handy at wearer's side. Save time, money, clothing. Price KEY-BAK only $2.95

WRITE, or WIRE FOR CATALOG. KEY-BAKs can save you money!

West of Mississippi: LUMMIS MFG. CO. 2242 E. Foothill Blvd. Pasadena, Calif.

East of Mississippi: CTL COMPANY 1710 W. Stewart Ave. Wausau, Wisconsin

G-E unveils TVX

by **F. T. Tancula**

RAPID (up to 10 ft per minute) production line inspection by X-ray is possible with a new system introduced Sept. 10 by General Electric Co.'s X-Ray Department, Milwaukee.

Known as TVX, the X-ray image intensification process permits economical 100% product inspection on a television screen 10,000 times brighter than a conventional fluoroscopic image. The image is bright enough for easy viewing in normal light, and the viewing monitor provides an image size electronically variable from one-half to three times that of the original object. (The camera covers a pickup field up to 6⅞ in. in diameter.)

Comparable to closed-circuit television, TVX permits addition of extra monitors (or ordinary TV sets) if observation from two or more points is desired. It consists of three basic units—X-ray sensitive camera, control unit, and monitor. The system, which costs approximately $7,500, can be used with any standard X-ray generator.

Heart of the unit and credited by G-E engineers as the key to the success of TVX is the camera tube, which allows direct transfer of X-ray energy to electron energy capable of being displayed on a TV monitor. Three energy conversions contributing to a high noise level have been eliminated.

The system allows product inspection as far as 1,400 ft from the camera, with the monitor and inspector thus safely remote from any radiation hazard. It permits safe use of any X-ray intensity necessary for adequate penetration up to the limit of the generator being used.

G-E representatives told us that TVX is not a substitute for film radiography as there are many applications where permanent records are needed. However, TVX is seen as a tool for expanding the fields where 100% radiographic inspection is used and in applications where film is now used unnecessarily.

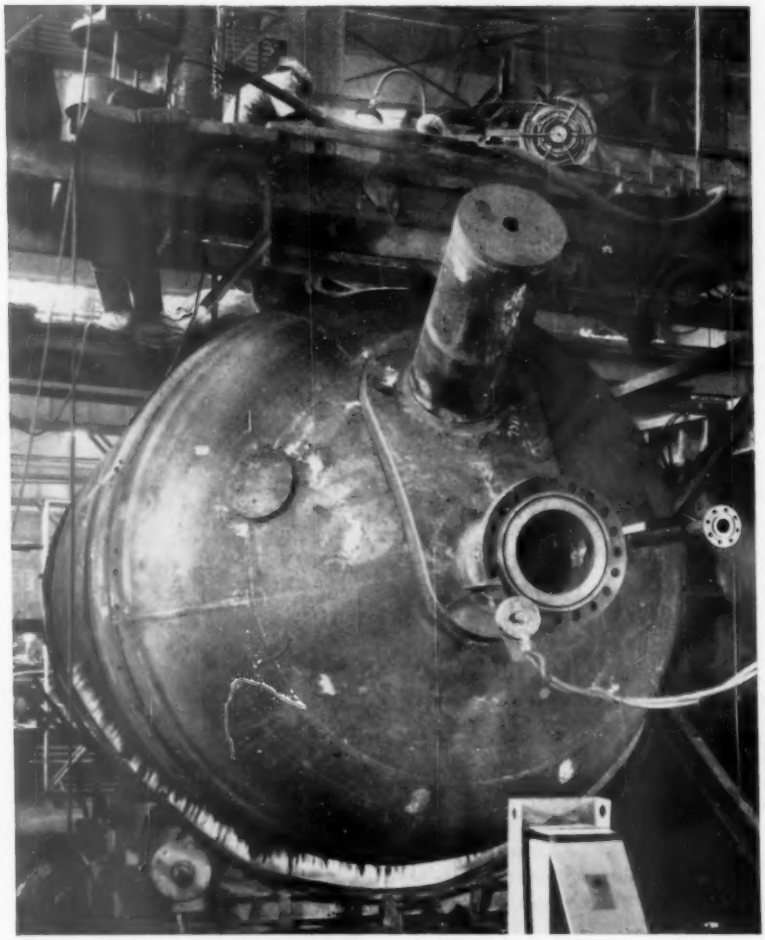
The camera weighs 20 lb, is 11½ in. wide, 17½ in. deep and 11¼ in. high. Control unit weighs 66 lb, is 15 in. wide, 22 in. deep and 8⅝ in. high. The monitor weighs 88 lb, is 15 in. wide, 22 in. deep and 16⅜ in. high.

Power requirements for the TVX system: 110/117/125 volts a-c, ± 10%, 60-cycle, single-phase, 530 watts. Input power is divided as follows: camera, 55 watts; control, 305 watts; monitor, 170 watts.

For any stainless welding job

SPECIFY *Drawalloy* CORPORATION

Stainless Steel Welding Wire



Spooled for Inert Gas Shielded Metal Arc Welding

Coiled for Submerged Arc Welding

Cut Lengths for Inert Arc Welding

Specify Drawalloy "quality controlled" stainless steel welding wire for *your* next "quality weldments." Your greatest advantage is experience . . . our experience in producing wires for welding exclusively. Because we are specialists, Drawalloy stainless steel welding wire is produced to strictly controlled specifications to provide the right chemistry, finish and temper for the finest quality weld metal and smoother operation in your automatic or semi-automatic equipment. Drawalloy stainless wires are available in all popular grades as well as 2¼ Cr, 1 Mo; 1¼ Cr, ½ Mo.

Why not discuss your stainless welding wire needs with your Drawalloy Distributor or Representative . . . a man with the products and knowledge to help you. Bulletin 355 DC provides complete information on every grade of Drawalloy wire. Write to: Drawalloy Corporation, Lincoln Highway West at Alloy Street, York 12, Penna.

DRAWALLOY
CORPORATION
YORK, PENNSYLVANIA

THE WIRE MILL FOR THE WELDING INDUSTRY — STAINLESS STEEL · TOOL STEEL

Shield them with economical barriers of J-M ALUMINIZED Asbestos Cloth

Radiant heat is a major cause of discomfort and fatigue that reduces efficiency and causes accidents. Economical new J-M *Aluminized* Asbestos Cloth reflects 90% of all radiant heat . . . helps maintain high production and good safety practices.

This new J-M material is a rigidly tested combination of aluminum and Asbestos. It retains a great degree of strength at temperatures up to 1400°F —over long periods of time—and can be used for curtains, shields, blankets, hoods and covers to protect workers from flame as well as radiant heat.

For further data, write Johns-Manville, Box 14, New York 16, N. Y. Ask for Brochure TX-2A.

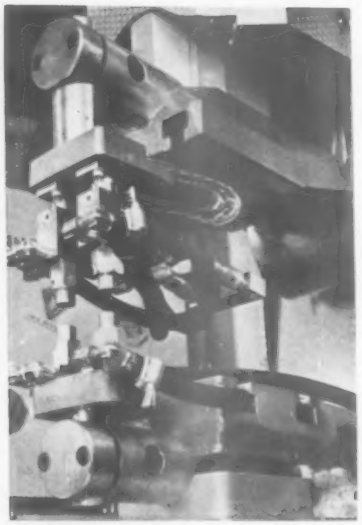
PORTABLE SHIELDS for emergency jobs near heat or flame can also be made with this J-M *Aluminized* Asbestos Cloth.

JOHNS-MANVILLE

100 YEARS OF QUALITY PRODUCTS . . . 1858—1958

NEW PRODUCTS

USE CARD ON PAGE 115



Die adapter

NEW design of Nu-Twist die adapter makes it possible to make two or more welds simultaneously on one machine with welding pressures and current equalized on each weld. Hydraulic equalizing adapters are latest addition to Nu-Twist adapters and inserts designed for fast change-over for short-run resistance welding. *P. R. Mallory & Co., Inc.*

Circle No. 1

Weld and charge unit

MODEL A180U weld and charge unit was designed for repair and maintenance operations of the farmer. The 180-amp unit can also charge 6 or 12 volt batteries while operating from any rural line, simply by plugging it into a 230-volt outlet. Accommodates all a-c electrodes from 1/16 through 5/32-in., and has two welding ranges: one for deep penetration, one for smooth surface welding. Meets REA, UL and NEMA standards. *A. O. Smith Corp.*

Circle No. 2

Face shield

POLYETHELENE Trojan Face Shield is designed to fit everyone. Comes with clear or green acetate windows, in 4, 6 or 8 in. lengths, and in 0.020 and 0.040 in. thicknesses. Three snaps securely fasten it to wide fibre spark guard. *Welsh Mfg. Co.*

Circle No. 3

Build-up electrode

COMPANY has new electrode, Build-Up (iron-powder-coating), claimed to have high tensile strength, resistance to cold flowing under compressive load, high impact strength, low tendancy to work hardening and limited increase in hardness under severe quench. Electrode has a deposition rate of 6-lb per hour at 250 amps. Operates on a-c or d-c (at either polarity), and may be applied in either stringer beads or wash passes. A two-pass weaved deposit on medium carbon steel shows a Rockwell "C" hardness 26; stringer beads on the same base metal give a Rockwell "C" 33 reading. *Stoody Co.*

Circle No. 4

Ultrasonic cleaner

NEW line of industrial cleaners includes six models of bench, floor and self-contained styles, all featuring forced air cooling and varying tank capacities ranging from 2 to 20 gal. All units operate on 110 volts, with a 60 cycle a-c current, with the exception of the largest unit which operates on 220 volts. Operating at 42,000 cycles per second, models in the series clean faster and more thoroughly using mild detergents, than ordinary methods using strong detergents, says manufacturer. *Gulton Industries Inc.*

Circle No. 5

Flux squeeze bottle

PINPOINTING of silver brazing flux can be accomplished with new plastic squeeze bottle containing Aircosil flux. Bottle prevents skin contact, waste, breakage, and reduces evaporation. *Air Reduction Sales Co.*

Circle No. 6

Arc welder combination

POWRWELD is a combination d-c arc welder of 200-amp capacity and an a-c power unit of 5 kw capacity. A-c power can be drawn from the unit for lights and tools while machine is being used for d-c welding. The d-c welding generator is rated 200-amps, at 25 volts, on 100% duty cycle, has 30 to 225 amp range for intermittent use, and will handle all types of electrodes. The same generator provides full 5 kw, 110/220 volt, single phase, 60 cycle a-c power. *Hobart Bros. Co.*

Circle No. 7

Metal removal torch

THE Arcair H-2 Torch is designed for intermittent applications and light uses. It has a positive air control valve in its handle, and can be operated at 40 psi of compressed air by holding the air orifice within 4 in. of the work. The small manually operated torch can be used by garages, farm and job shops, stone quarries, airplane manufacturers, and for light maintenance in all industries. *Arcair Co.*

Circle No. 8

For only $99 — you're "in business" with this PUROX W-200 Starter Set

You get all this standard, professional equipment:

- Welding Blowpipe
- Welding Head (welds up to ⅛")*
- Cutting Attachment (90° head)
- Cutting Nozzle (cuts up to 2")
- PREST-O-LITE Oxygen Regulator
- PREST-O-LITE Acetylene Regulator
- 12½-ft. Fitted Double Hose Assembly
- OXWELD Goggles with "A-A" Lenses
- OXWELD Friction Lighter
- Blowpipe Wrench
- Regulator Wrench
- Complete Setup and Operating Instructions
- Enameled *Steel* Carrying Case for everything

and—for a limited time only, at no extra cost—

How-To-Do-It Reference Library of 17 instructive booklets (total list price, $3.35). (Offer good during October, November, and December, 1958 only.)

*9 additional head sizes available, as required, for welding all metal thicknesses up to ½ inch

COMPLETE $99.00

This is a LINDE-built, high-quality welding and cutting outfit, designed for rugged service. All standard industrial equipment for maximum flexibility and portability.

Available now from your local supplier of LINDE products. If you don't know him already, write for his name and address. LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. In Canada: Linde Company, Division of Union Carbide Canada Limited, Toronto.

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UNION CARBIDE

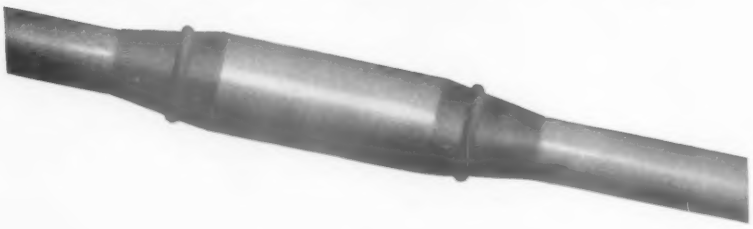
"Linde," "Oxweld," "Purox," "Prest-O-Lite," and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

NEOPRENE INSULATED . . .

WATERPROOF—SHOCKPROOF

CABLE CONNECTIONS and CABLE SPLICES

for Safety • Speed • Economy



You get all these Advantages with the new Cam-Lok System of Neoprene Insulated Cable Connections and Splices:

- **Completely safe in any kind of weather** . . . neoprene sleeve permanently vulcanized to cable jacket—can't pull away exposing bare wire. Connections won't shatter or crack under impact of trucks or heavy plates. Resist oil and gasoline too!
- **Exclusive Quick-Disconnect** . . . Cam-Lok gives you positive lock, high conductivity cable connections, yet they can be taken apart **instantly!** Join all cable sizes **without adaptors.**
- **Eliminates corrosion problems** . . . watertight, vulcanized seal prevents moisture from entering cable strands . . . assures longer cable life.
- **Tapered, tight and smooth** . . . exclusive Cam-Lok tapered Connections and Splices slide over or around obstructions as easily as cable itself . . . can't pull apart . . . eliminate production "bottlenecks."
- **Economical** . . . outlast ordinary connections 3-4 times. Long-life and trouble-free performance . . . vulcanized neoprene insulation supports cable at connection and eliminates breakage.
- **Quick . . .** you can make a Cam-Lok waterproof vulcanized Cable Connection or a permanent Cable Splice in minutes on the job. No training needed to operate Cam-Lok 110 volt portable Vulcanizing Kit. Connect or splice together all cable sizes without adaptors.

Write for new Cat. #131-B or see the complete Cam-Lok line at Booth #1039, National Metal Exposition, Cleveland, Oct., 27-31.

cam-lok DIVISION

EMPIRE PRODUCTS, INC.
P. O. BOX N-98 CINCINNATI 36, OHIO

Air-cooled welders

DROOPING-voltage arc welders are available in three types—250-amp d-c; 300-amp a-c/d-c and 300-amp a-c/d-c Heliwelder. All machines provide 115/250-volt, 10 kw, single phase, 60 cycle power when operated as power plants. They have 115-volt, 1 kw d-c auxiliary power available for operating lights and power tools while welding. *Air Reduction Sales Co.*

Circle No. 9

Guidance machine

TEMPLATES and patterns can be discarded when the Ultra-Graph guidance machines has its CA-30 Circle Guiding Attachment, adjustable to 44 in. in diameter, mounted. New attachment permits precise cutting and welding of circles when mounted on the machine's tracing head. *Heath Engineering Co.*

Circle No. 10

Spotweld nut

XN SPOTWELD nut incorporates new design and construction features to speed welding and assure optimum welds within a wide range of weld settings. Desinged to be welded to thin sheets, nut can give strength in small areas, says manufacturer. Thread engagement of the XN nut complies with Unified and American Screw Thread standards. Available in thread sizes of 6/32 through ⅜-16 from stock. *Ohio Nut and Bolt Co.*

Circle No. 11

Electrode oven

HOT-ROD electrode oven (No. 100) is of heavy sheet metal, with adjustable vent, thermostatic control with 200-550 range, 750 watt strip heater, and full length legs for bench setting. Oven can hold 300 lb and has voltage of 115 a-c/d-c, with 220 a-c on special order. *Rotir Co.*

Circle No. 12

Temperature indicators

AVAILABLE range of Tempil Pellets has been expanded to 2,550, 2,600, 2,650 and 2,700 F. These expanded ranges will be used in jet engine and rocket technology. *Tempil Corp.*

Circle No. 13

When the END RESULT must be FULL RELIABILITY

MAGNAFLUX TEST SYSTEMS

supply the MEANS

In today's missiles and aircraft, so much depends upon so little! As aircraft and missile men know, failure of just *one* of the many components linked together in complex systems, can put the whole system "out of business." *Every part* has become a critical part!

In this equipment chain, parts of *normally* high reliability can be intolerably *unreliable* as part of the whole interdependent system. When one failure in 1000 is too many — and may cost a million or more dollars — only reliability standards approaching the fantastic are good enough.

Similarly, only scientific inspection and testing systems can hope to maintain such standards.

Magnaflux Nondestructive Testing Systems provide the means. Proven practical and economical in just such uses, they enable you to assure the physical reliability of components — whether precious one-of-a-kind units or volume production items. These Test Systems are so precise in their findings that, in their recommended service, *not a crack, leak, or defect* that you need to find will go undetected. They cover the whole range of magnetic or nonmagnetic metals, ceramics or other materials you work with, design for, or fabricate. Also, eddy current Magnatest equipment controls metallurgy, heat treat, hardness, etc. — in further nondestructive tests.

These Magnaflux Test Systems are currently helping to assure near-infallability of materials for producers of components used in many missiles and aircraft. They are providing testing standards *to fit the need* . . . helping to keep both testing and production schedules *on schedule* . . . and saving a great deal of money for prime and subcontractors besides! Note, too, you don't need to buy test equipment. We have service testing facilities in 16 cities.

To find out what Magnaflux Test Systems can do for *you* write for a meeting and idea session with an experienced Magnaflux Engineer. You set the time and place. There's no obligation, of course — but plenty of help for the asking.

MX Test Systems—used for *more* test operations than *all* others—include:

MAGNAFLUX-MAGNAGLO
Magnetic particle testing for cracks and defects in magnetic metals.

ZYGLO
Fluorescent penetrant marks defects in nonmagnetic materials.

SONIZON
Ultrasonic testing for thickness or sub-surface defects.

STRESSCOAT
Brittle coating stress analysis.

MAGNATEST
Electronic testing for hardness, conductivity, cracks, etc.

Also others. Tell us your needs.

MAGNAFLUX CORPORATION

7326 West Lawrence Avenue • Chicago 31, Illinois

New York 36 • Pittsburgh 36 • Cleveland 15 • Detroit 11 • Dallas 35 • Los Angeles 22

The Hallmark of *Quality* in nondestructive test systems

NOTHING EVEN COMES CLOSE

TO THE AMAZING

TEC VISUWELD® TORCH!

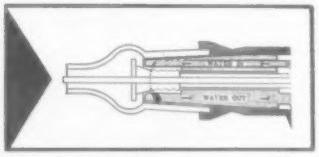
The TEC VISUWELD water cooled torch is the talk of the Industry because it's the ONLY torch to combine ALL these exclusive features for outstanding TUNGSTEN INERT GAS WELDING.

***ORIGINAL* VISUWELD TRANSPARENT GAS NOZZLE . . . YOU SEE WHAT YOU WELD!**

An unrestricted view of the weld while welding with durable, fog-free Quartz, Vycor or Pyrex nozzles.

***EXCLUSIVE* "TIP-OF-TORCH" COOLING FOR COOLER OPERATION! . . .**

Cooling system design affords continuous coolant water to reach tip of the torch. No need for "cooling off time" even at 350 amps.



PLUS THESE AND OTHER FEATURES:

***GUARANTEED* GAS AND WATER LEAKPROOF! . . .**

One-piece unit torch head with NO fittings or gaskets allowing NO water or gas to escape.

***LIGHTEST* WEIGHT TORCH... ONLY 3 OUNCES!**

Three ounces of working weight and an inch of diameter mean easy handling, faster fatigue-free operation.

3 TORCHES IN ONE!...

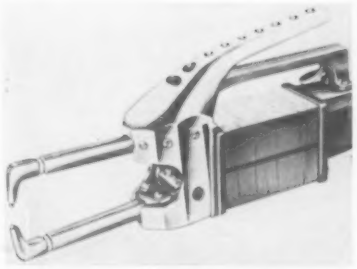
Weld efficiently, continuously from 3 to 350 Amps. . . . AC or DC. No need to change torches.

NO MAINTENANCE PROBLEMS!...

One-piece construction coupled with durable materials eliminate parts wearing out. No replacements are required.

Write NOW for full information on the TEC Visuweld Torch and Other Superior Visuweld Equipment

TEC TORCH CO., INC. 300 PATERSON AVENUE CARLSTADT, NEW JERSEY



Portable spot welder

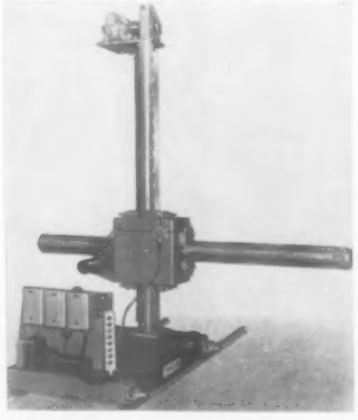
PATENTED, fixed top tong is an exclusive time-and labor saving device on the Rex Junior portable spot welder. Top tong allows the operator to rest the welder's weight on the exact welding spot for added contact pressure. Rex Junior was developed for use in small sheet metal shops and garages. It welds mild steel, stainless, galvanized and terne plate, and has a three conductor 9½-ft power cord and plug. The 110 volt model is terminated with a standard appliance plug to fit any wall socket, the 220 volt tool has a three-prong plug and matching three prong receptacle which fits standard box. *Peer Inc.*

Circle No. 14

Box furnace

TYPE RB-45 atmosphere box furnace is compact unit designed for continuous operation at all heat levels to 2,000 F. Chamber is 8 by 13 by 5 in., protected by an automatic flame curtain which ignites when furnace door begins to open. *Lindberg Engineering Co.*

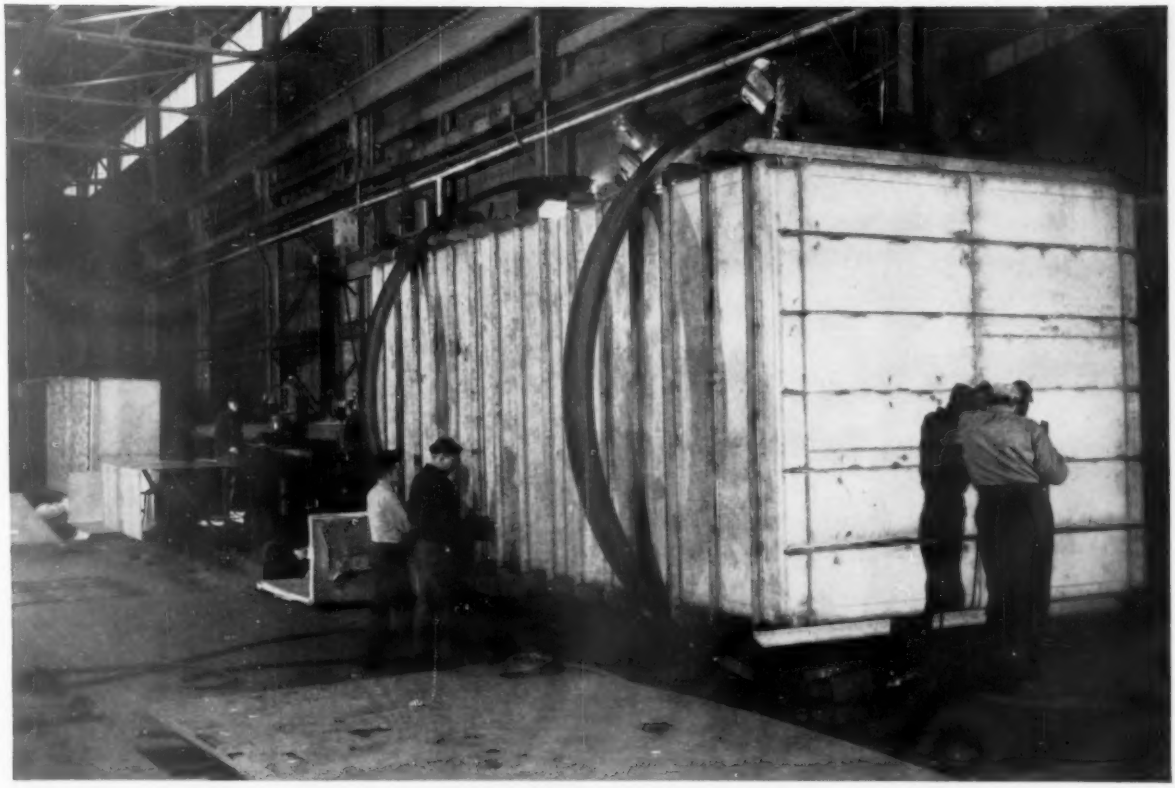
Circle No. 15



Manipulator

PIPER series manipulator is an economy model designed for a full automatic welding head. Available in two sizes. Model 606 has 6 ft vertical arc height and horizontal boom travel. Model 808 has 8 ft vertical arc height and horizontal boom travel. Powerized elevation with brake motor, constant speed, pushbutton control and manual column rotation is standard. *Pandjiris Weldment Co.*

Circle No. 16



For Stainless Welds with Quality Plus . . .

CHICAGO STEEL TANK CO. specifies

ARCALOY STAINLESS STEEL ELECTRODES

The large tank illustrated above is one of several constructed by Chicago Steel Tank Co.,* Chicago, Ill., designers and fabricators of steel vessels. These vessels, which measured 8 feet wide, 9 feet high, and 20 feet long, were fabricated of type 304 stainless steel plate. The welding procedures employed were the responsibility of Henry Rouson, welding engineer, who selected Arcaloy type 308 AC-DC stainless steel electrodes for all of the manual welds.

Henry Rouson specified Arcaloy electrodes for this job, just as he has for many others. The requirements for quality at CST demand a little more than the usual high quality expected of a stainless steel electrode. Good appearance and uniformity of weld are considered extremely important.

* A Division of U. S. Industries, Inc.

Stainless steel or stainless clad material is used on critical applications for its corrosion resistance and high strength properties and the fabricator of these materials knows that electrode selection must be made with care to preserve these qualities. Alloy Rods Company has provided in Arcaloy stainless steel electrodes all of the necessary qualities for sound stainless welding, plus welding characteristics which have made this electrode a favorite of both welding management and their weldors.

There are 25 types of Arcaloy stainless steel electrodes in lime or AC-DC (titania) coatings that will improve your products . . . provide a better quality weld metal. Write for Bulletin AR-10-2 Alloy Rods Company, P. O. Box 1828, York, Pennsylvania.

Alloy Rods Company

YORK, PENNSYLVANIA • EL SEGUNDO, CALIFORNIA

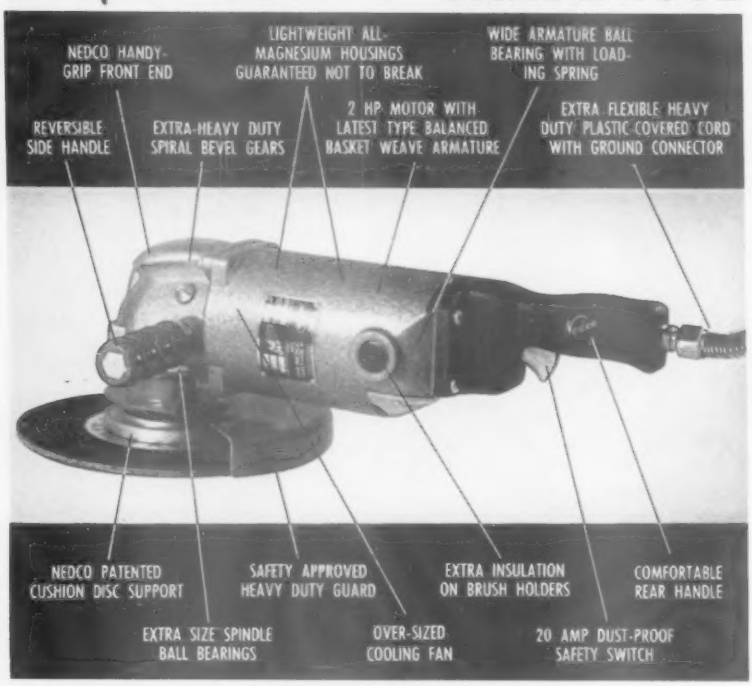
QUALITY WELDING ELECTRODES FOR
Stainless Steel
Mild & Low Alloy Steels
Cast Iron
Tool Steel
Bronzes & Dissimilar Metals
Hard Surfacing Electrodes & Wires

NO FINER ELECTRODES MADE . . . ANYWHERE

LOOK AT THESE OUTSTANDING FEATURES ON THE MODEL E-2

SINCE 1926

Nedco SANDBRUTE


NEDCO HANDY-GRIP FRONT END
LIGHTWEIGHT ALL-MAGNESIUM HOUSINGS GUARANTEED NOT TO BREAK
WIDE ARMATURE BALL BEARING WITH LOAD-ING SPRING
REVERSIBLE SIDE HANDLE
EXTRA-HEAVY DUTY SPIRAL BEVEL GEARS
2 HP MOTOR WITH LATEST TYPE BALANCED BASKET WEAVE ARMATURE
EXTRA FLEXIBLE HEAVY DUTY PLASTIC COVERED CORD WITH GROUND CONNECTOR
NEDCO PATENTED CUSHION DISC SUPPORT
SAFETY APPROVED HEAVY DUTY GUARD
EXTRA INSULATION ON BRUSH HOLDERS
COMFORTABLE REAR HANDLE
EXTRA SIZE SPINDLE BALL BEARINGS
OVER-SIZED COOLING FAN
20 AMP DUST-PROOF SAFETY SWITCH

Get The Best . . . Get The Genuine Nedco . . . The Grinder With 30 Years Experience Behind It

A two horsepower 9" grinder—and **built to use it all**—the NEDCO SANDBRUTE is the first choice of men who want a grinder of unsurpassed power for hard continuous grinding jobs. Grinder weighs only 13¼ lbs. No load speeds: 5300 or 6000 as specified. Handles fast cutting 9" discs efficiently at maximum speed. **Overload current cut off optional.**

NEW **Aerial Type Grinders for use with High Speed Cutting Wheels**

2 Models — 6 in. and 5 in. Wheel Diameters
1½ and 2 Horsepower — 7,000 R.P.M.

WRITE FOR CIRCULAR ON COMPLETE LINE

Genuine Nedco Tools are Made Only by:

THE Nedco COMPANY 27 JONES ROAD, WALTHAM 54, MASS.

Paste solder

PAINT-ON paste solder for use on stainless steels is oxidation-resistant and remains shiny under normally corrosive conditions, manufacturer states. Can be used for spot welded and wrapped seams, filling holes; is recommended for food contact applications. *Eutectic Welding Alloys Corp.*

Circle No. 17

Voltmeter

PORTABLE model UV-1 Voltmeter measures up to 600 volts, a-c or d-c. Four voltage ranges can be selected—0-150 a-c; 0-150 d-c; 0-600 a-c; 0-600 d-c. Readings are taken by inserting safety plug into receptacle on instrument and then connecting voltage leads to the line. Accuracy is 2% on d-c, 3% on a-c. *Columbia Electric Mfg. Co.*

Circle No. 18

Power unit

BE-CO universal power unit can be used as a positioner, or auxiliary power source for various types of machine equipment. The unit operates at a maximum of 400 lb circumferential turning force and at a speed of from 3 to 26 in. per minute. The motor is a 115 volt, a-c/d-c ¼ hp unit. It has a gear reducer ratio of 440 to 1, a pulley ratio of 3¾ to 1 (low pulley), and 2½ to 1 (high pulley). The sprocket gear box to drive ratio is 2 to 1. *BE-CO Engineering Co.*

Circle No. 19

Temperature indicators

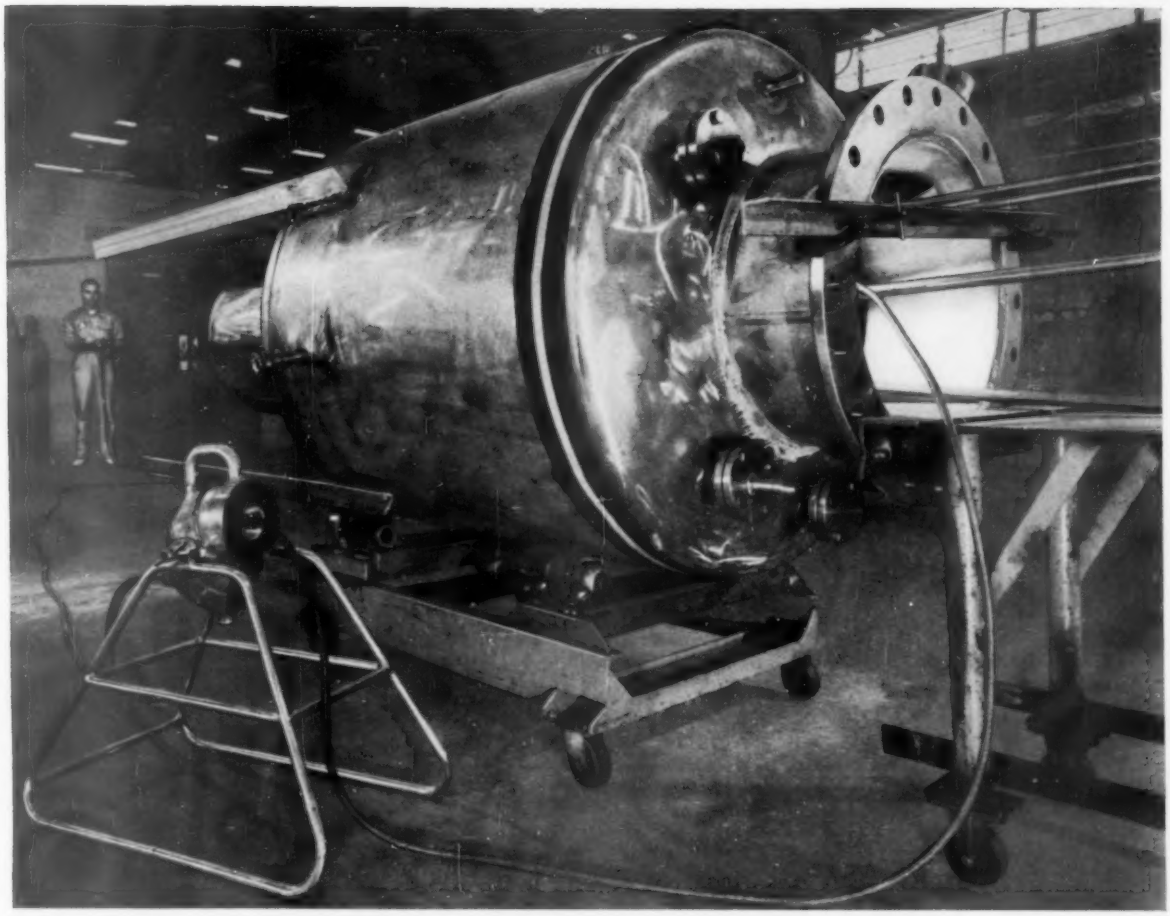
TEMPILSTIK ratings of 305, 320, 330 and 345 F, which provide closer temperature-interval calibrations in electronic, rubber and plastic applications, are available. *Tempil Corp.*

Circle No. 20

Tig torch

VIS-ARC water cooled, 500 amp Tig torch, W7-500-K-G, comes in water and air cooled models. All models have a fiberglas washer between nozzle and silicon rubber insulated head. *K-G Equipment Co., Inc.*

Circle No. 21



OAK RIDGE NATIONAL LABORATORY USES NUCLEAR SYSTEMS' RADIOGRAPHY MACHINES

The Oak Ridge National Laboratory, operated by Union Carbide Nuclear Company for the United States Atomic Energy Commission, is using radiography machines developed and manufactured by Nuclear Systems, a division of The Budd Company, for inspection of nuclear facilities.

Shown above is an operator using Nuclear Systems' Model 30, checking a circumferential weld on a fabricated stainless steel pressure vessel, an evaporator used for waste disposal processing of radioactive materials.

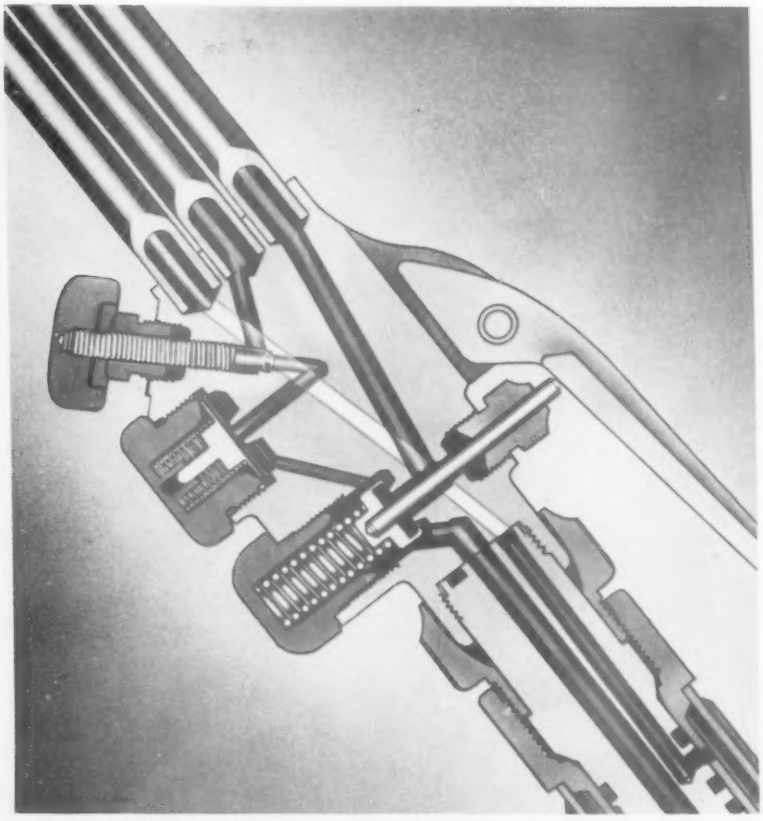
Within 10 minutes the operator can make an *internal* exposure of a complete circumferential weld, using iridium 192.

Weighing only 55 pounds, the Nuclear Systems' radiography machine Model 30 is ideally designed for portability and in-shop exposures. Call on Nuclear Systems for your radiography equipment needs. Offices in Philadelphia, Chicago, San Francisco and Los Angeles. Sales representatives in principal cities. Catalog on request.

Visit our booth at the National Metal Exposition, Cleveland, Oct. 27-31.

NUCLEAR SYSTEMS
A DIVISION OF THE BUDD COMPANY, Philadelphia 32

Budd



This spring-loaded, diaphragm-type, back pressure check valve greatly reduces the number and effect of backfires. Developed and patented by Smith's, "Flo-Trol" prevents the back flow of oxy-acetylene mixtures. It's exclusive, standard on all Smith's cutting assemblies.

BONUS . . . the World's Best Repair Service when you use Smith's equipment!

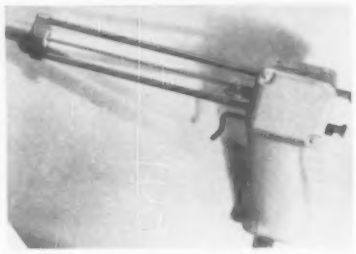
Users' experience has shown that the safety features such as Flo-Trol valves developed in our welding and cutting equipment mean fewer repairs as well as safer working conditions. This low frequency of repairs is the reason we can afford to back our products with the World's Best Repair Service.

Here's how it works: when a piece of your Smith's equipment becomes inoperative, you exchange it for a 100% factory reconditioned piece of the same equipment . . . completely overhauled, with new seats, packing, seal rings, and newly refinished in bright nickel. No matter what the damage to your equipment, your only cost is a low flat-rate repair charge. *And there's no waiting:* you make an on-the-spot exchange at your Smith's distributor. Just bring in your damaged equipment, pick up a like-NEW replacement!

For more information about the World's Best Repair Service covering all major items currently manufactured, *write:*

SMITH'S

Smith Welding Equipment Corporation
2623 Fourth Street S.E., Minneapolis 14, Minn.



Spot welder

SPOT welding from one side of the work without distortion of back-up can be done with new Schott panel welder, designed for use with any welding machine with an a-c or d-c rating of 125 amps or more. Welder has special powdered-iron-coated welding rod with starting tip, which starts immediately upon contact with work. Rods available in 1/16 and 5/64 in. diameters. Manufacturer claims machine is solution wherever welding is desirable but welding from two sides is difficult or impossible. *Schott Metal Products Co.*

Circle No. 22

Thyratron

NEW xenon-filled thyratron for ignition firing and motor control has spade lug connections to eliminate tube failure due to poor socket connection. Neither ELC3J/L's life nor reliability of control are affected by ambient temperatures or mounting position. Tube has a continuous average anode current of 2.5 amps d-c, oscillograph peak current of 30 amps, peak forward voltage of 900, peak inverse voltage of 1,250, a filament voltage of 2.5 and a filament current of 9.0 $\pm$ 2.0 amps. Tube carries two year life warranty. *Electrons Inc.*

Circle No. 23

Mask goggle

FLEXIBLE mask goggle 482A has a large, deep mask that gives good facial fit. One-piece plastic, impact-resistant lens curves slightly to increase worker's field of vision, and fit over prescription glasses. Comes with clear frame, and clear or green lens. *American Optical Co.*

Circle No. 24

Ultrasonic drill

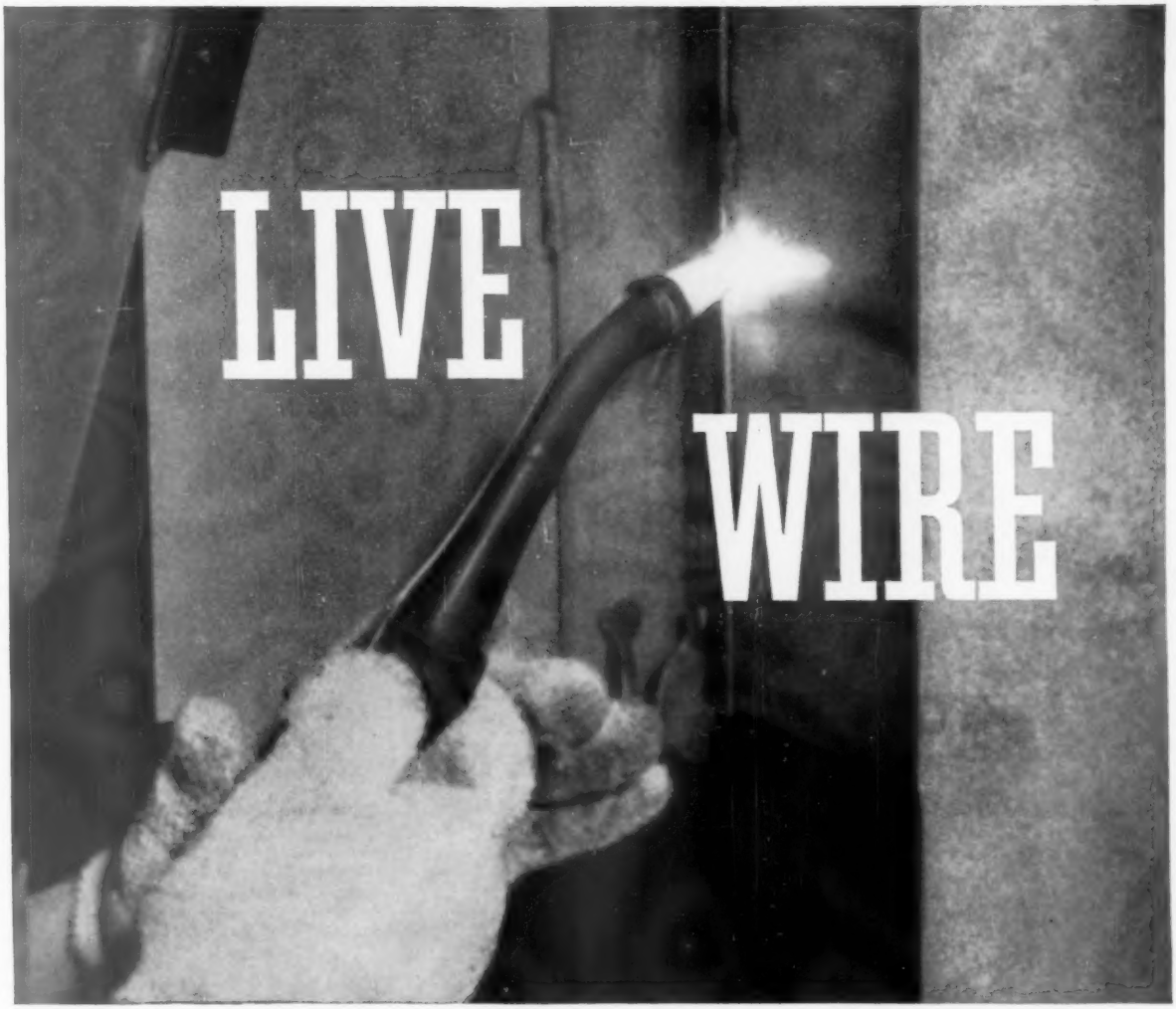
WITH power output of 100 watts, new ultrasonic drill "Glennite U-602" is designed for rapid drilling of intricate shapes in hard, brittle materials such as ceramics, tungsten, carbide, germanium, etc. U-602 includes two basic units, drill assembly and ultrasonic generator. *Gulton Industries, Inc.*

Circle No. 25

Combination welder

COMBINATION a-c/d-c transformer-rectifier welder is small, yet delivers a-c ranges of 20-115 and 60-180, and a d-c range of 40-150 amps. Manufacturer says this is adequate, and then some, for nearly all tasks encountered in job shops, garages, small industries and on the farm. *Miller Electric Mfg. Co., Inc.*

Circle No. 26



New design in Sigma hand welding torches

Here is a new, lightweight torch—only 16 ounces—for manually welding light-gage steels. Sigma ST-2 welds in all positions with no change in control or current settings. Welds .030- to .100-in. sheet, using low-voltage short-arc technique with .020- and .030-in. hard-drawn wire. For 200 amp continuous service, a-c or d-c.

Balanced design makes handling easy. Service lines enter through rear of handle—a convenience in cramped quarters. Start-stop switch on handle, easy to reach. Nozzle has a 60° curve for maximum weld visibility.

Sigma ST-2 makes high-quality welds at high speed. Seams require no cleaning . . . distortion is at a minimum. Inert gas shielding is economical. Low flow rate—only 10 cu. ft. or less per hour—means even more savings.

Call your nearest LINDE office today for a demonstration of this new Sigma ST-2 torch! Or write Dept. WE-10, LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N.Y. Offices in other principal cities. In Canada: Linde Company, Division of Union Carbide Canada Limited.

Linde TRADE-MARK

UNION CARBIDE

"Linde" and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

ELECTRIC-ARC INC.

One of a Series on Applications of Electric Arc's Smith-Dolan Units — Today's Most Versatile Heat-Treating Tools.

STOP WELD FAILURE *with the* SMITH-DOLAN SYSTEM *of Low-Frequency Induction Heating*

Here is the versatile heat-treating tool you need for producing sound welds easily and economically in carbo-alloy and other types of steel pipe . . . here is precision control of heating cycle when pre-heating and stress relieving — uniform, through-and-through heating of solid sections up to two feet thick and more — pushbutton operation — complete portability for on-the-job heat treating anywhere.

Many Money-Saving Applications — The Smith-Dolan System simplifies and upgrades work quality in numerous applications ranging from welding to forming and annealing. Units are available for 60 cycle heating in capacities ranging from 10 to 150 KVA . . . for 400 cycle heating . . . resistance heating. Pre-engineered with complete instrumentation, accessories.

"On Trial" Installations on Rental Basis — Prove the many Smith-Dolan advantages in your own plant without capital investment. Write, wire or phone.

Electronic recording gives permanent charts of heat run on this standard Smith-Dolan model. Coils permit work at 50 feet or more from unit. Eye hooks provide for easy handling by crane. Products ranging from a fraction of an inch to 10 feet in diameter can be heat treated on the job.

New Brochure — Send today for your copy of "Smith-Dolan System of Low-Frequency Induction Heating."

Electric Arc, inc.

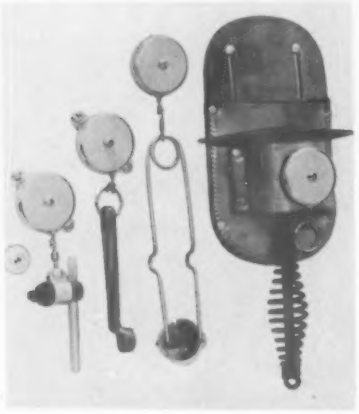
152-3 JELLIFF AVENUE, NEWARK 8, N. J. Bigelow 3-3211

Representatives in Principal Cities

Coated weld wire

PAGE A-S-18 copper coated welding wire was specially designed, alloyed and processed to weld the AISI-1025 steels. When used with CO_2 welding processes or with a neutral flux submerged-arc procedure on .35 carbon steel joints, wire has a tensile strength of 75/81,000 psi, a yield strength of 55/61,000 psi, and an elongation of 24%. Can also weld, in two passes, the AISI-1100 series of sulphur bearing or free-machining carbon steels. *Page Steel & Wire Div.*

Circle No. 27



Tool pouch

TIME saving, handy device is Key-Bak Pouch specially designed to be worn at weldor's belt. The 11-W pouch with Key-Bak attached is genuine leather, designed to carry chipping hammer, and other small tools. A 24-in. chain for carrying a flint-lighter is attached. *Lummis Mfg. Co.*

Circle No. 28

Hand torch

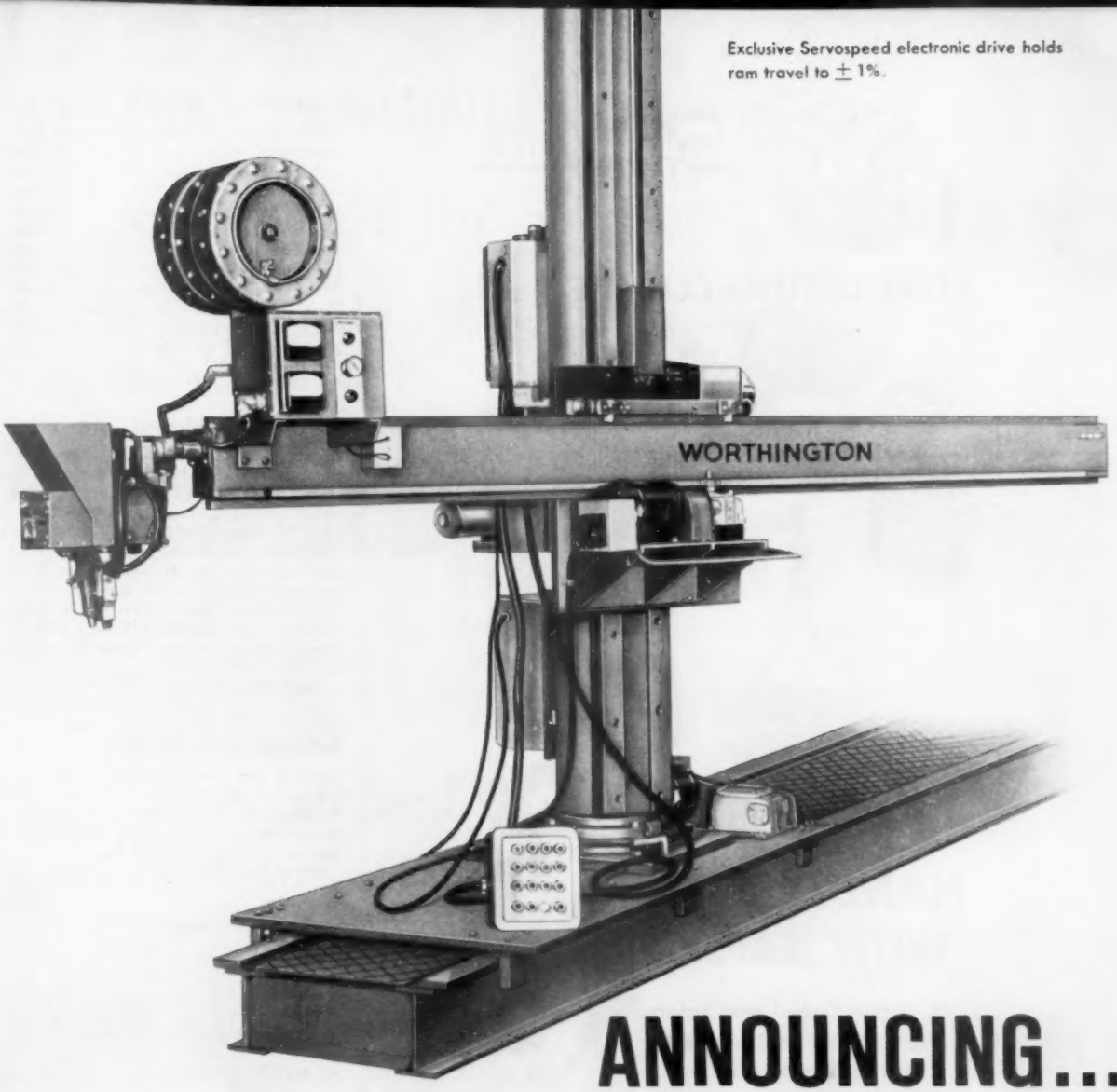
HAND torch, available with or without integral flame control valve, combine die-pressed, kiln-fired, perforated refractory screen with a heat resistant alloy pilot ring. It produces an effectively piloted spear flame, allowing wide turn-down without flame blow-off or flashback, manufacturer says. Can be used with any commercial fuel gas and any air gas mixture system which will develop required pressure. Five standard sizes provide heat release from 500 Btu/hr to 32,800 Btu/hr. *Selas Corp. of America.*

Circle No. 29

Brazing alloy

NICROBRAZ 50, containing chromium and phosphorus for high-temperature service, is recommended for application where high strength minimum penetration and low neutron absorption is required. Free-flowing material is oxidation resistant up to 1,575 F. Average solidus and liquidus is 1,630 F; normal dry hydrogen brazing temperature is 1,800 F. Available as powder, plastic bonded wire, flux-powder paste or prefabricated rings. *Wall Colmonoy Corp.*

Circle No. 30



Exclusive Servospeed electronic drive holds ram travel to ± 1%.

ANNOUNCING...

NEW AUTOMATIC WELDING HEAD MANIPULATOR three times more accurate!

Worthington has specially designed a series of welding head manipulators to meet the most stringent automation requirements.

This new line is available in sizes from 6′ x 6′ to 12′ x 12′. And each manipulator is equipped with the Servospeed electronic drive, far and away the most accurate of all electronic drives. It will control ram and carriage travel to ± 1% of set speed. (Up to now you've had to be satisfied with a spread of 6% or more!)

PLUS:

Rigid construction: mast of heavy tubular steel; ram is a fabricated steel box section, with precision machined ways for accurate travel.

Adjustable roller clusters grip 3 ways—assure a rigid ram with practically no deflection!

Positive drive carriage with adjustable limit switches on track.

Full 360 degree rotation: positive lock clamps mast in any position.

Wide speed range: from 3.47 to 149 inches per minute.

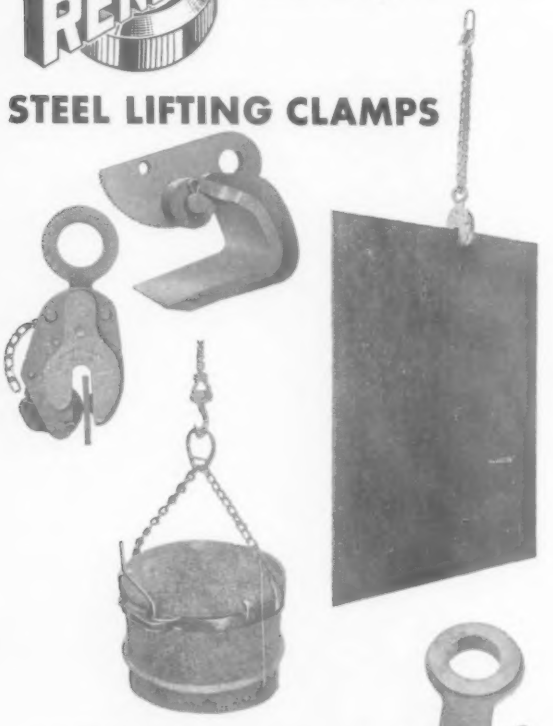
Brake motor for vertical travel for better control, more accuracy. Allows minor vertical changes to be easily made.

Write today for the detailed bulletin on these new manipulators, built in the world-famous Worthington tradition: precisely engineered for accuracy, completely tested for safety, and constructed to give years of steady, trouble-free service. Worthington Corporation, Positioning Equipment Division, Section 55-3, Harrison, N. J.

WORTHINGTON

RENFROE Safety Snap Lock

STEEL LIFTING CLAMPS



HANDLE STEEL WITH SAFETY

√ Maximum Speed and Safety
√ From ½ ton to 20 ton sizes
√ Lock on in any position
√ Lock off in any position
√ Exceptionally light in weight
√ The toughest clamp ever built
√ Takes the place of welded pad eyes and screw clamps
√ Cannot be accidentally knocked off
√ Safety Factor 5 to 1

A Superior Line of Steel Lifting Clamps designed to meet today's demand for handling steel with maximum SAFETY and EFFICIENCY.

WRITE FOR COMPLETE CATALOGUE

J. C. RENFROE & SONS, INC.
1259 WEST STATE STREET • P. O. BOX 4279
JACKSONVILLE, FLORIDA

Heavy duty welder

GASOLINE or diesel engine powers new d-c heavy duty welder used for arc and stud welding. Welder is rated 600-amp, 40 volts on 60% duty cycle, has a 70 to 800 amp current range with 1 kw auxiliary power of 110 volts d-c available while welding. Gasoline driven model GM-618-S is powered by Chrysler IND-56A V-8 engine with 354 cu in. piston displacement. Model DM-618-S is powered by a General Motors 3055C Diesel with 212.8 cu in. piston displacement. *Hobart Bros. Co.*

Circle No. 31

Welding magnifier

SUPERSITE Welding Magnifier is designed to fit all welding helmets. Manufacturer claims it makes welding easier, safer and faster by enlarging and improving visibility of work. Can be used by weldors who wear prescription glasses as well as those who have normal vision. Supersite is fitted with Glensite lenses, and offers eight focal strengths ranging from 0.75 to 2.50. Frame is gold butyrate channel with a clearly marked diopter. *Glendale Optical Co., Inc.*

Circle No. 32

Bending accessories

BENDING post and horizontal clamp are two accessories introduced for use with welding platen or bending blocks. Said to be versatile, new tools can be put to many uses. *Acorn Iron & Supply Co.*

Circle No. 33

Portable screen

SINGLE unit portable screen can be used as welding shield, partitioner or shield for grinding and other machines where protection is needed. Light in weight, screens come in sizes to 6 by 8 ft. *Singer Glove Mfg. Co.*

Circle No. 34

Welding head track

COMPANY claims accurate production welding of foil steels and other metals as thin as 0.003 in. is possible with its series of precision side beam tracks. Tracks are for alignment, support and longitudinal traversing of welding heads and variable speed carriages above welding positioners. Stable tracks, 12 by 3¾-in., are said to be particularly effective in welding honeycomb panel facings. Available for weld lengths of 6, 8, 10 or 12 ft. *Airline Welding and Engineering.*

Circle No. 35

Crusher jaws

KENCO Cross-Rib crusher jaws are claimed to increase crusher efficiency and production. Manufacturer says they bite with every strike, thereby reducing abrasive wear caused by rocks which slip back instead of breaking. Available for most popular makes and sizes of crusher. *Kenco.*

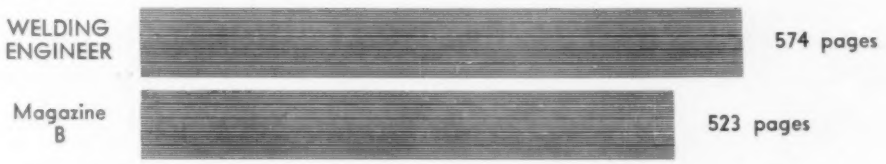
Circle No. 36

WELDING ENGINEER

Continues the welding leader

. . . in Advertising Sales

Pages of Display Advertising*

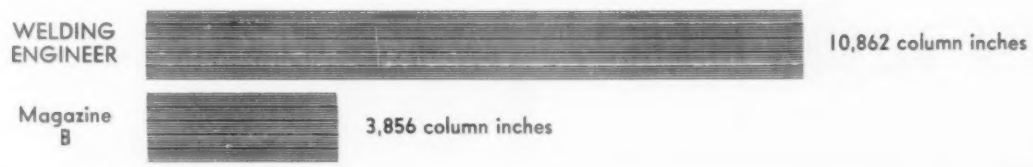


*January-September, 1958

Again this year, WELDING ENGINEER is carrying more ad pages than any other welding publication . . . evidence that advertisers have confidence in its ability to reach the right people at the right time.

. . . in Editorial Quality and Quantity

Editorial Material*



*January-September, 1958

During the first nine months of this year, WELDING ENGINEER has published 10,862 column inches of timely, accurate welding information . . . giving its readers nearly three times more editorial service than the second book in the field. But quality is also ours for . . .

Editorial leadership means advertising readership, and ***Welding Engineer*** leads in both. The past four years mark ***Welding Engineer*** as the fastest-growing book serving the welding market.

For welding market information, write or wire

WELDING ENGINEER • 5826 Dempster • Morton Grove, Ill.

ULTRASONIC WELDING*

SONOWELD®
AN IMPORTANT
NEW WELDING CONCEPT

Shown above is SONOWELD Model No. W-2000-SR-57-10, one of several sizes of units. At left below is an actual size photograph showing a .002 aluminum foil lead ultrasonically welded to an aluminum capacitor can.

Ultrasonic Welding Without Fusion

SONOWELD is a revolutionary new metal-joining technique which uses vibratory or high-frequency sonic energy to produce a solid-state metallurgical bond between similar or dissimilar metals.

It is superior to usual methods of welding in many applications. It is applicable to industrial use with metals and shapes heretofore impossible or difficult to weld.

There is no arc, spark, sputter, or contamination with SONOWELD equipment. Welding is done at relatively low temperatures, with low clamping force, negligible deformation. Joints are excellent in a wide variety of metals and metal alloys.

Write for more information. Tell us your specific welding problem or application.

SONOBOND CORPORATION
A SUBSIDIARY OF AEROPROJECTS, INCORPORATED
WEST CHESTER, PENNSYLVANIA
Manufacturers of Ultrasonic Metal-Joining Equipment
SONOWELD® • SONOBRAZE® • SONOSOLDER

*Ultrasonic welding — originated and developed by Aeroprojects Incorporated

Contact protectors

SELENIUM contact protectors for a-c voltages eliminate arcing and erosion across the contacts of relays, switches and other components, says the manufacturer. Series available are: 1) encapsulated diode types for limited space applications, protectors measure only 0.01 cu in. 2) fibre-type cartridge type and 3) hermetically sealed cartridge types for application in environmental extremes. *International Rectifier Corp.*

Circle No. 37

Stretch cables

NEW to the cable industry is a conductor that stretches 200%, retracts and can be built economically, manufacturer says. Cables are made in 2 and 3-conductors, capable of carrying up to 2 amps. Terminations are in spade, clip, probe or round. Jackets are nylon, rubber or neoprene. Wire is used for portable tools, etc. *Stretch Wire Corp.*

Circle No. 38

Transformers

SUBMARINE hunter-killer aircraft, the "Argus," uses six different types of transformers developed especially for a-c electrical distributions systems in aircraft. The transformers were designed to supply power for various instruments and equipment in the CL-28 aircraft, the largest plane ever built in Canada. *Sylvania Electric Products, Inc.*

Circle No. 39

First-aid cabinet

WHEN fast, immediate first aid treatment must be given, a new first aid cabinet is a safeguard. It is small enough to mount near hazardous areas. Catch on each door prevents opening because of nearby vibrations. Finished in white enamel, cabinet dimensions are: 66 in. high, 24 in. wide and 12 in. deep, 11 cu ft, weight about 52 lb. Cabinet may be bought stocked with first aid supplies. *General Scientific Equipment Co.*

Circle No. 40

Demagnetizer

INDUSTRIAL-type demagnetizer with 6-in. tubular opening is for quickly demagnetizing production parts and products before finishing or assembly. It removes metal dust and particles as parts drop through. Tapered design with magnetizing intensity reduced toward exit lets work fall free. Unit available in various lengths. *R. B. Annis Co.*

Circle No. 41

ducing the case's plate thickness by approximately 50%, when compared to flange-quality carbon steel. The T-1 alloy has a minimum yield stress of 90,000 psi, a minimum elongation of 18% and an ASME working stress of 26,250 psi. The design tensile stress used in the scroll case is 24,000 psi.

The scroll case is the first of four to be erected and fabricated by CB&I for the $87,000,000 Noxon Rapids Dam project.

IIT research building to be dedicated

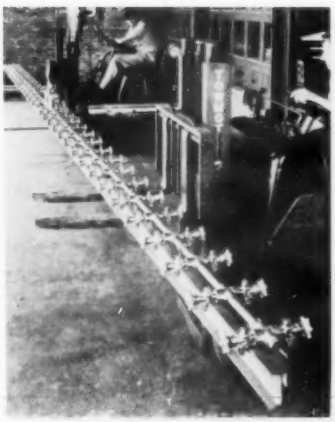
Illinois Institute of Technology's $1,200,000 addition to the Armour Research Foundation metals research building will be dedicated Oct. 20. The four-story addition will complete the second step of a 10-year expansion program announced in 1956, and will more than double the previously available space for metals projects.

The addition will provide space for study on electrochemistry, and applied, powder, reactor, physical and non-ferrous metallurgy. The original metals building will be devoted entirely to a pilot plant, and welding, foundry, steel making and other metallurgical processes.

To complete the ARF 10-year expansion program another addition and two more buildings will be constructed in an attempt to modernize, enlarge and consolidate the ARF's physical plant.

Liquid Carbonic moves Chicago offices

Liquid Carbonic Div. of General Dynamics Corp., Chicago, has moved to new offices at 135 S. LaSalle St. in that city.



In the field of industrial gases, 64 cylinder oxygen charging manifolds like this one aren't produced every day. Bastian-Blessing Co., Chicago, produced this one for cylinder filling plant of Liquid Carbonic Div., Cleveland. Bastian-Blessing is celebrating its 50th anniversary this year.

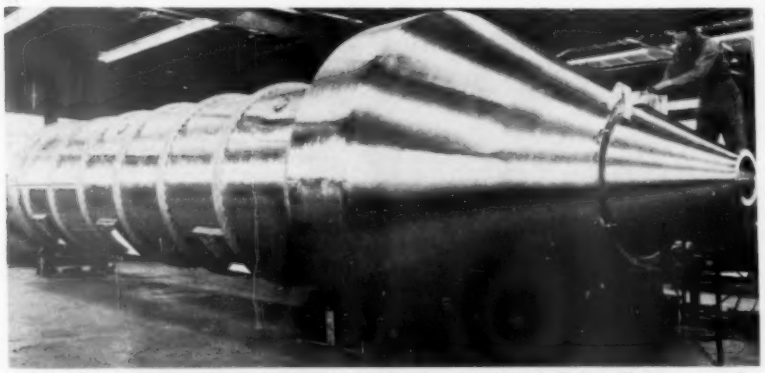
Blacksmiths and weldors hold annual convention

Floyd Whitten was elected president of the Blacksmiths and Weldors Association at their recent convention held at the Warden and Wahkonsa hotels, at Fort Dodge, Ia. R. C. Skerries was named "Smith of the year."

GE opens tube, parts sales office

General Electric Co. has opened an expanded electronic tube and components sales office in San Mateo, Calif., to serve equipment manufacturers in seven western states.

E. N. Phillips, district sales manager, will handle sales of receiving and computer tubes to equipment manufacturers, and Thomas C. Andersen, district sales manager, will handle sales to distributors of electronic tubes, semiconductors and vitrious enameled resistors.



DRYER, used for experimental research on the spray drying of whole milk, was recently installed at University of Wisconsin, Madison. Welded structure, made by Kreuger Fabricating Co., Madison, used 12,000 lb of type 304 Armco stainless steel.

you get

SINGLE PASS FILLETS

and

DEEP GROOVE WELDS—

with

HIGH SPEED

and

HIGH QUALITY

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AIRCO 315

* Airco 315 electrodes are unsurpassed for flat or horizontal fillets, and flat position butt welds.
* Weld pressure vessels, and their piping connections.
* Handle heavy machine weldments, practically all heavy steel and structural assemblies.

. . .

Airco 315 electrodes deposit metal of outstanding properties, including good tensile strength, high ductility, and freedom from porosity. Permit high welding currents, without excessive spatter. Give deep penetration, and fast deposition of metal.

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Authorized Airco Dealers in principal cities

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A division of Air Reduction Company, Incorporated

150 East 42nd Street, New York 17, N. Y.

Open house attracts 750 visitors

MISSISSIPPI Valley Structural Steel Co., Melrose Park, Ill., recently held an open house that attracted 750 visitors. At left, young visitor demonstrates ease with which new semiautomatic submerged-arc equipment is used. Above, arc-welding demonstration attracts visitors. Foundation for Education in Welding reprint on "Modern welding practices" was distributed to guests.

Automatic welding saves $7 thousand

Production speed was increased by 300%, and $7,000 was saved on one production run of pipe welded with the "Unionarc" method of welding steel perfected by Linde Co., that firm reports. At the Denver plant of Thompson Pipe and Steel Co., the method replaced automatic-arc welding with flux-coated electrodes. "Unionarc" is now used at the plant to make all girth-seam butt welds on 14 to 30 in. diameter mild steel pipe which ranges from 3/16 to ¼ in. thick.

Olin Aluminum chooses New York headquarters

National sales headquarters for Olin Aluminum's division of Olin-Mathieson Chemical Corp., have been moved to a newly-completed building at 400 Park Ave., New York.

Atomic submarine carries twin-reactors

Recently launched atomic submarine *Triton* is said to be the first vessel equipped with twin nuclear reactors.

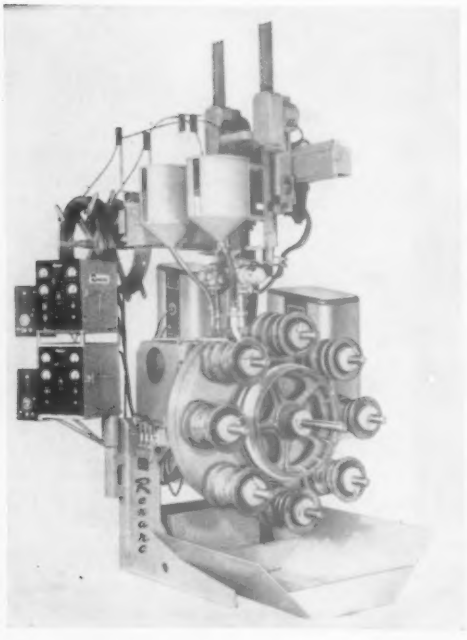
World's largest submarine consumed 450,000 lb of electrodes in its all-welded construction, as 88,000 ft of piping was installed. Welding techniques used in the construction included one that made it possible to weld stainless steel pipe with a minimum of deformation to produce a smooth internal and external finish.

Fred L. Plummer, National Secretary of the American Welding Society, was present when *Triton* was launched.

CB & I adds spectrograph to research laboratory

Chicago Bridge and Iron Co., Chicago, has added a spectrograph and allied equipment to its metallurgical research laboratory at Birmingham, Ala. The new equipment rapidly analyzes the metallic constituents in ferrous and non-ferrous materials. Its facilities will be devoted to the analysis of materials included in CB & I's Hortonclad vacuum bonding process, electrodes, deposited welds and plate and sheet materials.

Revolutionary *Rexarc* Enables High Speed Production in Tractor Roller Rebuilding



Here is the new *Rexarc* MS-8 Automatic Twin Head Roller and Idler Welder and Positioner that revolutionizes roller rebuilding. One operator can do as much high quality work as three to four men with other types of equipment.

•

Mounts 8 rollers at a time. Hydraulic indexing enables virtually a continuous automatic welding operation. Twin heads build up both sides of roller simultaneously.

•

Factory engineer trains your operator, assuring excellent results from the very beginning of welding operations, at no additional cost.

•

Write, wire or phone today for complete information about this revolutionary profit-maker.

Manufactured by

THE SIGHT FEED GENERATOR COMPANY

SALES OFFICES AND FACTORY, WEST ALEXANDRIA, OHIO, U.S.A.

1959 Western Metal Show to be held in March

The bi-annual Western Metal Exposition and Congress will be held by the American Society for Metals in Los Angeles during March, 1959. One of the cooperating organizations is the American Welding Society. Exhibits will be in the Pan-Pacific Auditorium and the technical sessions in the Ambassador Hotel. The displays will be designed to show western metal industries improved, helpful materials and equipment that will enable them to produce more at less cost.

Lukens produces new weldable alloy

After 18 months of testing, Lukens Steeel Co., Coatesville, Pa., has begun production of "Lukens Nine Nickel," an alloy plate with high impact resistance and strength at temperatures as low as —320 F. Experiments show the alloy to be weldable.

Acoustica gets western branch

Culver City is the site of Acoustica Associates, Inc.'s first western branch. The New York firm will occupy 8,000 sq ft quarters.

ALL-welded aluminum truss panels are main components of military tactical bridge. U. S. Army Engineer and Research Development Laboratories are testing panels for structural strength. Each 920-lb truss was fabricated from aluminum alloy 5456-H321 plate stock which has tensile strength of 42,000 psi. Trusses were fabricated by Aluminum Co. of America, Pittsburgh.

New AWS section at Nashville

The 81st section of the American Welding Society, and the fourth in Tennessee, has been formed in Nashville.

The first elected chairman is Burton C. Haworth, E. I. du Pont de Nemours & Co. Other officers are, vice president, John L. Bevill, Kerrigan Iron Works; secretary, Robert W. Liddle, Ford Glass Plant. Membership chairman is W. Michael Belew, Eutectic Welding Alloys Corp., and program chairman is Russell Staub, Industrial Electric Co. The executive committee consists of Jules U. Durham, American Bureau of Shipping; Miller C. Minton, Nashville Bridge Co.; and John H. McCann, McCann Steel Co.

NEW
ARO Model 410
Air operated gun with "Ski-lift" type gyro suspension
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Portable
SPOT WELDERS
with "SKI LIFT" type
gyro suspension
• Automatic timing
• Usually costs about half as much as gun-plus-transformer
• Works on existing power lines
• No power loss. Transformer built-in
• Handy, maneuverable—no heavy, unwieldly cables
Illustrated Literature on Request

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Now! THE NEW INEXPENSIVE WAY TO SOLVE YOUR SEVERE ABRASION PROBLEMS!

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HARDPLATE

Heat Treated High Carbon Steel

- Brinell hardness 230/250.
- Tensile strength 110,000 psi.
- Easily welded with L. H. electrodes.
- Machinable with high-speed tools.
- Easily fabricated in the field.
- Lasts from 3 to 10 times longer than mild steel.

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Group of RUEMELIN Fume Collectors Keeps Shop Clear of Welding Fumes

This well ventilated welding department is typical of hundreds of similar installations. Welding operators appreciate smoke and gas-free atmosphere. Thousands in service. Many repeat orders. Collecting fumes AT THE SOURCE with local exhaust hoods has proven most practical in operation. It is particularly helpful in winter months when doors and windows are closed. Write for Bulletin 37-D describing all types of Ruemelin Welding Fume Collectors.

RUEMELIN MFG. CO.

MFRS. & ENGRS. • SAND BLAST & DUST COLLECTING EQUIPMENT

3880 NORTH PALMER STREET • MILWAUKEE 12, WISCONSIN, U. S. A.

1959 Nuclear Congress slated for Cleveland

The 1959 Nuclear Congress will be held April 5-9, in Cleveland. It is called "the year's most comprehensive meeting devoted to peaceful uses of atomic energy." Its four sections will appeal to engineers, scientists, industrial executives, researchers and manufacturers of peacetime nuclear devices. The congress, whose theme is "For mankind's peace," will be open to any interested persons from the U. S. or abroad.

New package for brazing alloys

Special package tailored to odd-job requirements has been designed by Handy & Harman, New York City, for those who have only occasional use for brazing alloys.

Two types of general-purpose silver alloys are available in the small package—Sil-Fos, used to braze nonferrous metals such as copper; and Easy-Flo 45, an all-purpose alloy used to braze most ferrous metals.

For the benefit of new users each package contains instructions on the technique of torch brazing with silver alloys.

The Sil-Fos carton contains twenty 20-in. sticks of alloy, the Easy-Flo 45 carton contains 17 pieces of alloy wire 20-in. long.

Reynolds Metals sales relocates in Richmond

Reynolds Metals Co. has moved its entire sales headquarters from Louisville, Ky., to Richmond, Va. The move involves 400 sales employees, but does not affect any of the seven Reynolds aluminum fabricating plants in Louisville.

Houghton enlarges Detroit plant

A new addition more than doubles the size of the E. F. Houghton plant in Detroit. New machinery and materials handling equipment have been installed.

COMING EVENTS

OCT. 16-17: University of Wisconsin Institute on "Welding-Pressure Piping and Vessels," and "Basic engineering refreshers," Madison, Wis.
OCT. 20-24: National Safety Congress and Exposition, Hotels Conrad Hilton, Congress, Morrison, La Salle, and Hamilton, Chicago.
OCT. 27-28: NWSA West Central Zone Meeting, Hotel Muehlebach, Kansas City, Mo.
OCT. 27-31: 1958 National Metal Exposition and Congress, Cleveland Public Auditorium, Cleveland.
OCT. 30-31: NWSA Western Zone Meeting, Riviera Hotel, Las Vegas.
NOV. 11-12: Northwest Welding Conference, University of Minnesota, Minneapolis, Minn.
DEC. 1-2: NWSA Southeastern Zone Meeting, Dinkler-Tutwiler Hotel, Birmingham, Ala.
DEC. 4: NWSA Southwestern Zone Meeting, The Statler Hilton, Dallas, Tex.
DEC. 4: NEMA Arc Welding Section Quarterly Meeting, Chicago.
JAN. 26-29: Plant Maintenance and Engineering Show, Cleveland Public Auditorium, Cleveland.
JAN. 28-29: Midwest Welding Conference, Illinois Institute of Technolgy, Chicago.
MARCH 12, 1959: NEMA Arc Welding Section Quarterly Meeting, Pittsburgh.
MARCH 16-20, 1959: ASM Western Metal Exposition and Congress, Pan-Pacific Auditorium and Ambassador Hotel, Los Angeles.
APRIL 7-10: 1959 AWS Welding Show, International Amphitheater, Chicago, Ill.
JUNE 4-5, 1959: NEMA Arc Welding Section Quarterly Meeting, Hot Springs, Va.

Metal Powder industry forms federation

A new organization, the Metal Powder Industries Federation, will succeed the Metal Powder Association, that group voted at its recent meeting. The new organization is designed to bring together industry segments. The MPIF will include four trade divisions: Metal Powder Producers Association, Ferrite Mfg.'s Association, Metal Powder Core Association and Power Metallurgy Equipment Mfg.'s Association.

Wynn Laurence LePage, president of the Franklin Institute, Philadelphia, spoke at the MPIF meeting, held recently in Philadelphia.

Beryllium firm offers seminar

To learn how to work with beryllium, metal fabricators can arrange one-day seminars with the Beryllium Corp. Firms interested in a seminar should contact W. S. Pollard, The Beryllium Corp., P.O. Box 1462, Reading, Pa.

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IN THE RED DRUM

HIGHEST QUALITY

DUST FREE

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In coils, straight lengths, or preformed rings, Phoson and Sil-Bond brazing alloys are available through welding supply dealers everywhere in the United States.

Scientific Color analysis keys quality control of United Phoson and Sil-bond brazing alloys

Brazing results depend upon alloy uniformity . . . that's why United scientifically controls this vital factor through the modern miracle of **spectrographic analysis.** Skilled technicians **arc test** United Phoson and Sil-Bond alloys. This sets up a color spectrum which is analyzed by ultramodern, spectrographic equipment . . . and results in the most positive alloy check ever developed!

Spectrographic control coupled with United's continuous casting production processes are the reasons why Phoson and Sil-Bond alloys assure uniform results, speed up production and reduce finishing requirements.

A colorful new 8-page booklet, "Low Temperature Brazing Engineering Facts and Data" is packed with valuable information which you need for more profitable brazing. A copy is yours free. Write, wire or phone, today.

UNITED WIRE AND SUPPLY CORPORATION
1497 Elmwood Avenue, Providence, Rhode Island

Specify **UNITED** *for brazing alloys, aluminum, brass, copper tube and wire*

Plan to visit Booth 1142 at Cleveland Metal Show Oct. 27-31

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MATERIAL HANDLING DEVICES

- Safety Factor—5 to 1
- Factory tested at triple rated capacity.
- Will lift from horizontal or vertical position.
- Cam and Pads of case hardened tool steel.
- All operating parts replaceable when worn.
- Swinging or jerking loads will not affect grip.
- Useful for positioning in welding operations.

The HEAVIER the LOAD . . . . . the TIGHTER the GRIP! 3-T-17

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WELDER BRUSHES

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TO eliminate "dishing" of deck plates by trucks and cars carried by *Evergreen State* ferry boat, Puget Sound Bridge & Dredging Co., Seattle, used Jones & Laughlin Steel Corp., Pittsburgh, 12-in. Junior beams slit to form tees and welded to underside of deck plating on 13½-in. centers.

Navan switches to Los Angeles

Navan Products Inc., subsidiary of North American Aviation Inc., is moving its general offices from Santa Monica to Los Angeles.

Navan specializes in marketing such inventions as diamond cutting wheels, a high-strength aluminum alloy, a new static seal for hydraulic fittings, and an all-metal preservative.

Lithium firms work to develop alloys

A working agreement designed to lead to commercial development of new lithium-containing metal alloys has been established by Lithium Corp. of America, Inc., Minneapolis, and Brooks and Perkins, Inc., Detroit. Both companies will participate in research on alloys containing lithium and other metals.

Inco develops new refining process

Scientists and engineers of International Nickel Co. of Canada, Ltd., recently developed a new process for the electro refining of nickel. The process features direct electrolysis of nickel matte, an artificial sulphide, eliminating high-temperature oxidation and reduction operations. For the first time in nickel refining, elemental sulphur and selenium can be recovered as valuable by-products.

ASCE meet to review structural engineering

The most recent advances in structural design, research in the behavior of structures and properties of materials, and construction techniques will be discussed at the national convention of the American Society of Civil Engineers in New York City, Oct. 13-17.

Peace through building subject of book

A new book titled "Building for peace and prosperity," is being published by Exposition Press Inc., 386 Fourth Avenue, New York 16, N.Y. A subtitle states the theme of the book, "Increased construction: Key to the future." Written by architect Robert Shepard Hale, member of the American Welding Society, the book concerns world construction plans.

Consulting engineers sponsor seminar

"Composite steel and concrete construction design," as applied to bridges was the subject of a recent seminar sponsored by the New York Association of Consulting Engineers. Dr. Ivan M. Viest of Ottawa, Ill., chairman of the joint committee on composite construction of the ASCE and the American Concrete Institute, discussed the design of composite structures as an example of the practical utilization of research studies.

Testing firms in merger

Tulsa Testing Laboratory, Inc., has been merged with the United States Testing Co., Inc., Hoboken, N. J. The Tulsa firm has been in business for more than 25 years, doing all types of testing including radiography, welding engineering and oil and gas analysis. James B. Davis, president of Tulsa Testing, will remain as manager, with the present staff.

G-M tests roofs for ventilation

General Motors Corp., Detroit, recently announced its formula for emergency roof ventilation of industrial plants to aid fire control and minimize damage. In effect, draft curtains in prescribed locations on the underside of the roof fence-off ceiling areas to confine the smoke and hot gases within zones from which they can be vented by monitors or roof ventilators.

CUT COSTS!

Blast Metal Away with ARCAIR

Here's metal removal to beat anything you've ever seen before! Arcair Torch cuts, gouges, grooves, bevels or flushes off *any* metal . . . does it faster, cheaper, through a revolutionary combination of the electric arc and ordinary compressed air.

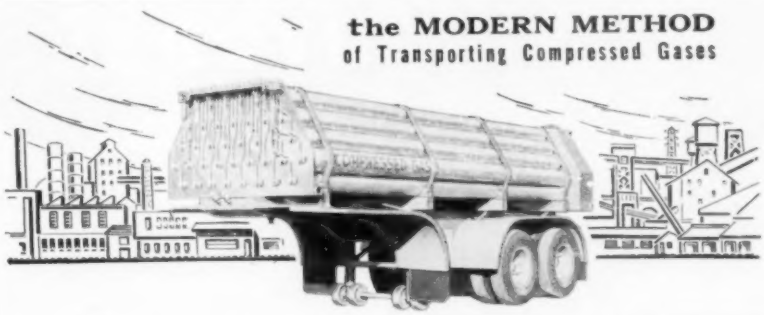
Inexpensive to install, economical to operate, easy to use —Arcair works with any standard arc welding machine.

WRITE TODAY FOR COMPLETE INFORMATION!

Arcair Metal Removal Torches

427 S. Mt. Pleasant St., Lancaster, Ohio

the MODERN METHOD of Transporting Compressed Gases



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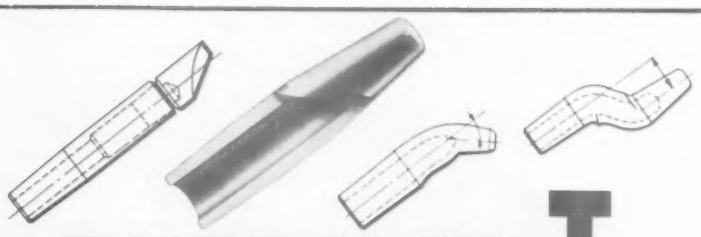

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Resistance Welding Alloys

• **SPOTWELDING TIPS, a complete line . . .** R.W.M.A. Standard Tips, 'Tuffcap' Standard Tips, Cold-Formed Tips, Copper-Tungsten Faced Tips and many "Specials", all *carried in stock* in a wide selection of active types and sizes.

• **BAR STOCK,** round, hexagon, square and rectangular.

• **FORGINGS,** a large stock of bars and wheels available for finishing. Special forgings to order, rough, or finish-machined.

• **WELDING TIP HOLDERS and ADAPTERS**

You too may depend on *Tuffaloy,* with its record of over twenty years of prompt service and consistently high quality.

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- *An all-industries essential*
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North American Philips Company, Inc.
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Pipeline News

American Louisiana Pipe Line Co., Detroit, Mich., has been granted a permanent FPC certificate to expand their pipeline facilities at a cost of $7,492,000. The expansion will increase its average daily capacity by 35,700,000 cu ft, raising its total to 357,000,000 cu ft. Two 12,000 hp compressor stations will be built, and 3.2 miles of pipe line constructed.

Permanent certification by the FPC has been given Tennessee Gas Transmission Co., Houston, Texas, to construct and operate pipeline facilities to cost $169,329,263. Pipeline construction of 1,072 miles, and increased compressor horsepower of 104,250 will raise the company's daily delivery capacity by 405,599,000 cu ft.

FPC permission was granted Natural Pipeline Co. of America to construct 490 miles of 36-in. and 21 miles of 26-in. loop lines between Fritch, Tex., and Joliet, Ill.

Ohio Fuel Gas Co., Columbus, Ohio, was authorized to construct 51 miles of pipeline on various parts of its transmission system in Ohio. The facilities will cost $2,163,000.

United Fuel Gas Co., Charleston, W. Va., can build an additional underground natural gas storage pool in Kanawha County, W. Va. The project will cost $1,571,000, and will include 3.3 miles of 16-in. line, and 7.3 miles of storage field line and measuring facilities.

Dates set for Midwest Conference

The fifth annual Midwest Welding Conference will be held January 28-29 on the Illinois Institute of Technology campus, Chicago.

The conferences bring together welding researchers and users to discuss current developments in the field. Sponsored by Armour Research Foundation of IIT, and the Chicago section of the American Welding Society, past conferences have drawn 250 persons.

The 1959 program will include 12 papers dealing with the latest development in welding processes and applications.

Distributor appointments

John H. Hosking Co., Cincinnati: Wallace Supplies Mfg. Co., Chicago.

Graham Mfg. Corp., Needham Heights, Mass.: Wiley Welding Supply Inc., Los Angeles; Thermo Tech Prod. Co., Denver, Colo.; Correll Engineering Co., St. Louis.

About people . . .

Neil

Lawson

Pollack

Carter

Appointment of three men to fill newly created positions has been announced by National Cylinder Gas Div. of Chemetron Corp., Chicago. Appointed were: *Hayes W. Neil*, Rocky Mountain regional manager; *Edwin L. Lawson*, Denver district manager and *Herbert H. Pollack, Jr.*, Pueblo district manager.

James N. Alcock, president of Saginaw Welding Supply Co., Saginaw, Mich., has purchased the stock formerly owned by vice president *Robert P. Gehring*. Gehring is now sales manager of Cayuga Machine and Fabricating Co., Inc., Depew, N. Y. *Donald S. McGill* has been elected to succeed Gehring as Saginaw vice president, and was also elected to the company's board of directors.

Troy G. Cox is the new branch manager for Harris Calorific Co., Dallas, Tex. He will coordinate all marketing and selling activities relative to Harris, its distributors and dealers in Texas.

Chicago Bridge and Iron Co., Chicago, has assigned two engineers to company sales offices in Chicago and Kansas City. *Harry G. Pazucha* has joined the Chicago sales staff and *Richard J. Bassett* has been transferred to Kansas City.

L. K. Stringham has been elected vice president, research and development, of the Emerson Electric Mfg. Co., St. Louis. Stringham recently resigned from the Lincoln Electric Co. of Cleveland.

Walter F. Greenwood is the new manager of marketing for the General Electric Receiving Tube Dept., Owensboro, Ky. He will be responsible for marketing metal-ceramic tubes, computer and special purpose tubes and entertainment types.

A. E. Carter has been elected vice president of manufacturing for the Worthington Corp., Harrison, N. J. He replaces *Leslie C. Ricketts*, who will devote his time to the five Worthington operating divisions he is group vice president of. Carter was manager of a Ford Motor Co. parts plant and at one time was associated with Nash-Kelvinator Corp., now American Motors.

Thomas S. McCrory, former Lt. Commander in the U. S. Navy, is now regional manager of Wheelabrator Corp.'s west coast sales organization. He will headquarter in Los Angeles.

Latest addition to the sales organization of Bay State Abrasive Products Co. is *Adam H. Killermann*. He will be responsible for sales in Florida.

Gen. James H. Doolittle is new chairman of the board of directors of the Space Technology Laboratories of Ramo-Wooldrige Corp., Los Angeles.

A. E. Nehrenberg, former research supervisor, has been named section manager, Technical Development Dept., Crucible Steel Co. of America, Pittsburgh. *R. W. Metter* has been appointed administrator—patents and licenses. Both men will headquarter in Pittsburgh.

Duane R. Branaka has been appointed sales manager of Valvair Corp., Cleveland, and will supervise sales of the Valvair line of manual and pilot-operated control valves.

Lindberg Melting Furnace Div. of Lindberg Engineering Co., Chicago, has announced the appointment of *Ray P. Dunn* as technical director. Dunn will be in charge of the technical development of the company's line of melting and holding furnaces for aluminum, brass, bronze, tin and other non-ferrous metals.

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Higher weld quality because of the excellent physical properties of this new electrode.
An easy contact type electrode that requires no skill by the welding operator for holding and restriking the arc. Weld is practically self cleaning—an electrode that handles an extremely wide range of welding applications.

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FUSE-WELL No. 11, *Square*—Gray Cast Iron Welding Rod for Acetylene use in filling or building up new or worn castings producing machineable welds.

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FUSE-WELL No. 14, *Moly*—An Iron Base Rod with alloys added for finer grain structure and greater strength.

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FUSE-WELL No. 22, *Electrode* — Light coated Rod to be used for AC or DC welding in the fabricating and repairing of cast iron castings.

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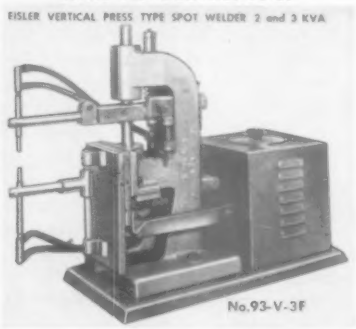

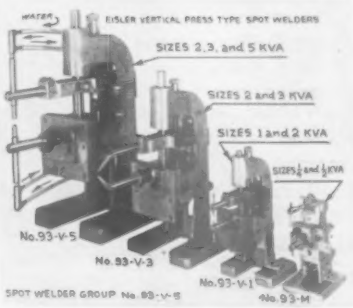

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Buechler

Behr

Former chief engineer for Electric Products Div. of Vickers Inc., St. Louis, *Lester W. Buechler*, has been appointed the division's general sales manager. *Joseph L. Behr* has succeeded Buechler as chief engineer. Both men are graduate electrical engineers.

O. H. Davenport, who served in several capacities for Linde Co. during his 39 years of service before retirement at 65, is the new sales promotion manager for Absco Inc., San Francisco distributor of electric welding apparatus.

N. Harvey Collisson has been elected president of Ormet Corp., aluminum producing company jointly owned by Olin Mathieson Chemical Corp., and Revere Copper and Brass Inc. Collisson, who had been corporate vice president for production and engineering, replaces *Walter F. O'Connell*, who is now corporate vice president for finance.

Vice president of C. B. Hunt & Sons, Inc., Salem, Ohio, is *Kenneth H. Meyer*.

Died . . .

Charles A. Medsker, former treasurer and factory manager of Gasflux Co., Elyria, Ohio, died Friday, Aug. 8.

Edmund J. von Henke, 79, died recently. Mr. von Henke was the founder and president of American Electric Fusion Corp., Chicago manufacturer of welding products.

New York City metallurgist, *Donald M. Liddell*, died recently at 79. Mr. Liddell is credited with discovering a way of recovering selenium in the process of refining copper.

The former president and director of Norton Behr-Manning Overseas Inc., *Herbert A. Stanton*, is dead at 71. Mr. Stanton was keenly interested in international banking, and, in addition to his duties at Norton Behr-Manning, he at one time was director of the National Foreign Trade Council.

Machine design

AIDS TO EFFICIENT MACHINE DESIGN IN WELDING STEEL. Published by Lincoln Electric Co., Cleveland, 1958. Paper, 8½ by 11 in., 88 pages. Price, $1.

In 12 concise chapters, "Aids to Efficient Machine Design in Welded Steel" presents practical rather than theoretical information on weld design that has been tested in use on a wide variety of machines.

The manual is an outgrowth of those needs which have been evidenced by a continuing series of machine design seminars conducted by Lincoln Electric Co. As such, it presents for the machine designer nomographs and data for either redesigning from an existing casting, or designing from calculated loads. It is shown that in some instances the job can be done by simply applying standard design techniques and formulas to the problems of designing in steel.

The areas covered include simple methods for redesigning cast bases and cast fly wheels, appraisal of steel design, efficient steel uses for bending loads, resistance to torsion, minimization of vibration, designing of bases and fly wheels to load conditions, design of bearing supports, fillet welds for strength, welds for bending and twisting, and welds for horizontal shear due to bending.

This is a compact book with much original material—one that should be in every welding designers library.

Non-destructive testing

SYMPOSIUM ON NON-DESTRUCTIVE TESTING. Published by American Society for Testing Materials, Philadelphia, 1958. Cloth, 6 by 9 in., 104 pages. Price, $2.75.

Non-destructive testing has become an important material inspection means for the welding industry in particular, and for all fields of engineering in general. This symposium, based on papers presented at the Second Pacific Area National Meeting of ASTM, presents the latest and most widely used testing techniques

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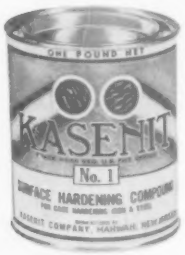

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together with their applications in various fields.

Practically everyone in welding will find something of interest in the collection, for we all know that the cost of testing which requires the destruction of a sample is, in many instances, prohibitive.

This book adds greatly to the fundamentals of non-destructive testing and allows the reader to become acquainted with many interesting advanced techniques.

While all papers are of interest, those of particular interest to the welding field are, "Non-destructive testing applied to railroad material and equipment," "Electronic X-ray image systems," "Fatigue and ultrasonic attenuation," "Ultrasonic technique for non-destructive evaluation of metal to metal adhesive bonds," and "Non-destructive testing of bonded metal sandwich materials."

Iron castings

ASTM STANDARDS ON IRON CASTINGS. Published by American Society for Testing Materials, Philadelphia, 1958. Paper, 6 by 9 in., 168 pages. Price, $2.75.

For the first time the 32 standards of the ASTM relating to iron castings have been compiled and published in a single volume. In addition to the standard on welding rods and electrodes, there are standards relating to pig iron, gray iron castings, cast iron pipe, nodular iron castings, malleable iron castings and general testing methods.

This compilation has long been needed. In a single book those working with cast iron will find a guide to all the materials they use.

ASTM standards

ASTM STANDARDS ON LIGHT METALS AND ALLOYS. Published by American Society for Testing Materials, Philadelphia, 1958. Paper, 6 by 9 in., 310 pages. Price, $3.75.

This handy compilation of ASTM specifications and methods of testing light metals and alloys includes 51 standards, 36 of which are new, revised or had their status recently changed.

Presented are three filler metal standards—arc welding electrodes, brazing filler metal and welding rods and bare electrodes. General topics covered include ingots, castings, bars, rods, wires, shape, forging, pipes, tubing, sheet, plate, wrought products and electroplating.

This volume is somewhat wider in scope than previous compilations. It includes specifications and methods

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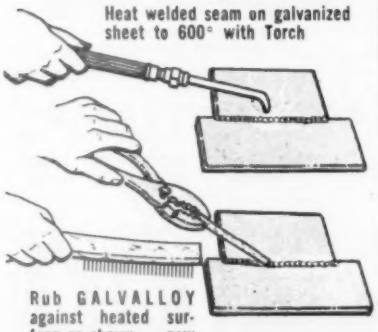

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of testing which come under the jurisdiction of committee B-7 on light metals and alloys, and those for light metal alloy die casting prepared by committee B-6 on die castings and those for aluminum wire and cable for electrical purposes sponsored by committee B-1 on wire for electrical conductors. To add to its usefulness the compilation includes several methods of testing under the jurisdiction of committee E-1, and methods of chemical analysis of metals by committee E-3.

Radioisotopes

SYMPOSIUM ON RADIOISOTOPES. Published by American Society for Testing Materials, Philadelphia, 1958. Cloth, 6 by 9 in., 100 pages, Price $2.75.

This is a compilation of papers presented at the Second Pacific Area National Meeting of ASTM. It covers testing techniques utilizing radioisotopes and demonstrates the wide range of industrial application to which they may be put. Some papers discuss changes in the physical properties of material exposed to radiation.

Use of radioisotopes saves hundreds of millions of dollars each year in terms of process and product improvements and knowledge gained. Broad information on radioisotope tracings are presented, along with case histories on electroplating studies, the evaluation of rubber deterioration, mechanism of detergency, analysis of traced materials by neutron irradiation, and achievement of process control by way of tracers during full scale petroleum operation.

Much can be gained from the text, its references and illustrations. Papers on precision industrial gaging of either moving or static solids and solution will present the reader with opportunities for future standards and useful applications.

Steel, concrete construction

COMPOSITE CONSTRUCTION IN STEEL & CONCRETE FOR BRIDGES AND BUILDINGS. By I. M. Viest, R. S. Fountain and R. C. Singleton. Published by McGraw-Hill Book Co., New York, 1958. Cloth, 6 by 9 in., 192 pages. Price, $7.50.

Saving money and the extensive use of welding in composite steel and concrete construction of bridges and buildings are two important factors discussed in this new engineering manual on design of beams and slabs.

Design methods are presented for the three most commonly used shear

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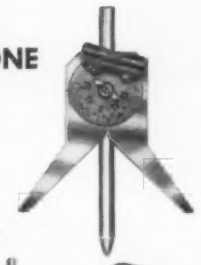

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connectors of composite construction—welded studs, flexible channels and spirals. Because of its numerous practical advantages the increasingly popular welded stud shear is extensively treated.

In a well-rounded discussion the authors give the basis for composite construction and its advantages, develop design equations and procedures, describe methods of connecting slabs to beams, and supplement all information with illustrated examples of design procedure, and design charts and tables.

In a unique presentation, supplemented by six completely illustrated examples, a rapid method is developed for the composite design of beams. Data is also presented on such special problems as determining length of cover plates, design of continuous beams and computation of deflections.

All methods and examples presented follow the provisions of the 1957 AASHO specifications for composite design of highway bridges. Possibilities of composite construction for building is discussed in some detail in the appendix.

Temperature properties

ELEVATED TEMPERATURE PROPERTIES of WELD DEPOSITS IN WELDMENTS. By Howard R. Vorhees and James W. Freeman. Published by American Society for Testing Materials, Philadelphia, 1958. Paper, 8½ by 11 in., 228 pages. Price, $5.50.

This book, which represents thousands of hours of work on the part of research laboratories of many large industrial firms, attempts to bring together in one place, all available elevated temperature data on steels and similar alloys.

Four basic sections cover welded carbon steel, welded chrome-molybdenum steel, welded stainless steel, and super-strength alloys. Data is presented for 30 varieties of steel welds. Listed are short time tensile properties, creep and rupture strength, chemical composition, welding rod, electrode or filler wire, weld groove designs, welding process involved, and welding conditions.

This is one of a current series of ASTM special technical publications summarizing properties of alloys at high temperatures. Increasing use of welding for high temperature applications in the power, oil, chemical and aircraft industries should make this an extremely helpful publication for design engineers, allowing them to use data closer to their welding application.

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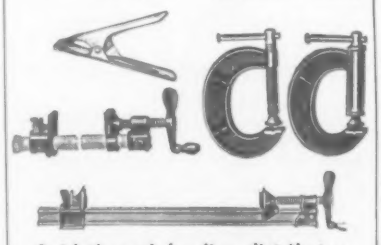

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SPOT WELDER, National, 40 KVA, Used.
CUTTING TORCHES, Used, Oxweld, Airco, Harris.
WELDING TORCHES, New, Rego GV.
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free literature . . . . . USE CARDS ON PAGE 115

51. SPRAY GUN—Metallizing Engrg. Co., Inc. Bulletin 125C describes ThermoSpray gun that sprays powdered ceramics and metals without compressed air. Diagram shows gun's features and pictures show gun in use.

52. HARDFACING — A. O. Smith Corp. Bulletin MW-222 contains data on more than 25 hardfacing electrodes and wires. Chart helps one choose correct item to use on more than 400 types of welding equipment.

53. ELECTRODE HOLDERS—Duro Engineering Co. Booklet includes pictures, specifications and prices of company's line of holders.

54. TRANSFORMERS — M&T Welding Products Corp. Brochure VVT-1 describes heavy duty variable voltage transformers. Includes specifications and illustrations.

55. LUBRICANTS—Alpha-Molykote Corp. Chart contained in bulletin 116 shows machine shop personnel where and how Molykote lubricants should be applied.

56. PROTECTIVE CLOTHING—Wheeler Protective Apparel Inc. Catalog illustrates and describes line of safety clothing which includes overalls, coats, hand pads, helmets, aprons, chaps and leggings.

57. ELECTRICAL ALUMINUM CONNECTIONS — Erico Products Inc. Four-page folder tells how Cadweld Aluminum A-22 Process welds aluminum to aluminum, and aluminum to copper. Gives physical properties of Cadweld connection.

58. ALUMINUM CORROSION—Du Pont Co. Illustrated report available that tells results of company's study on whether or not aluminum corrosion takes place in automotive cooling systems. Also tells what anti-rust chemicals gave best performance in tests.

59. NATIONAL ELECTRIC STORY — National Electric Welding Machines Co. Brochure gives account of company's progress over the past 25 years. Includes pictures and details of all welding machines in company's line.

60. ZIRCONIUM AND HAFNIUM—Mallory-Sharon Metals Corp. "Technical and application data on zirconium and hafnium" is a reference guide listing the mechanical and physical properties of the two materials. Effect of temperature on zirconium; the corrosion properties of zirconium, titanium and other metals; tips on fabrication; and application possibilities are included.

61. ULTRASONIC CLEANING—Branson Ultrasonic Corp. Bulletin S-200 explains practical applications and basic principles of the modern cleaning method, gives its advantages, and design of equipment.

62. STATIONARY COMPRESSORS—Joy Mfg. Co. Installation photos, sectional drawings and charts tell story of compressors designed for chemical processing, gas compression, etc. Bulletin A-93 includes specifications on four basic models which range in capacity from 368 to 2,000 CFM.

63. GRINDING WHEELS — Cincinnati Milling Products Div. "Cincinnati surface grinding wheels" describes straight sided wheels, segments, cylinders, cups and nut inserted wheels for surface grinding operations. Includes table of suggested gradings.

64. SAFETY GLASSES — Fendall Co. Flyer tells of company's multi-fit safety glasses with a bridge claimed to fit almost anyone. Includes pictures of other features.

65. TRANSFORMERS — Marcus Transformer Co., Inc. Catalog covers company's line of dry, oil and askarel-immersed transformers through 5,000 kva. Contains pictures, performance data, dimensions and specifications.

66. HYDRAULIC CYLINDERS — Miller Fluid Power Div. Information on Job-Rated Model "J" Hydraulic Cylinders for 500-2,500 psi service and Power-Packed Model "H" Hydraulic Cylinders for 3,000-5,000 psi service included in bulletin JH-104N. Also contains academic cylinder data on column strength, piston rod deflections, acceleration, factors of safety and cylinder forces.

67. COMPANY HISTORY — Metal & Thermit Corp. Color booklet covers company's activity over past 50 years. Company's products are fully described and illustrated.

68. GAS INDICATORS—Davis Emergency Equipment Co., Inc. "Combustible gas indicators" tells how to select proper instrument for a job, give proper training for use of instrument, and tells the testing procedures recommended to keep instruments operating accurately.

69. METAL STITCHING—Acme Steel Co. ". . . a new idea in fastening" is described in 16-page booklet which includes drawings, charts and specfications. Gives typical applications and tells how material costs have, in some cases, been cut by 66%.

70. ACCUMULATOR — Greer Hydraulics Inc. Different applications, sizes and types of hydro-pneumatic bladder-type accumulators are described in PR-200. Includes basic accumulator circuit applications, dimensional data, selection information for hydraulic circuits requiring pressure storage and fluid dispensing.

71. WELDING EQUIPMENT — National Cylinder Gas Div. Bulletin NH-138 describes two products that increase work-area mobility and versatility in semiautomatic welding. One is crane-held cage assembly to carry control and wire-feed unit, and an equipment carrier cart with telescoping boom for control and wire-feed unit.

72. ARC WELDING—Lenco, Inc. "Reducing costs by proper care of arc welding circuits" points out many things that can be done to keep electric arc welding circuits operating properly.

73. RADIOACTIVE MATERIALS—American Casualty and Surety Co. Report tells the full properties of radioactive materials. It also deals with production, health hazards and the handling of radioactive materials.

74. ALLOYS and FLUXES — All-State Welding Alloys Co., Inc. Catalog briefs data needed by buyers of specialty alloys and fluxes to help them with their particular problem. Covers steel and aluminum alloys, cast iron, copper, stainless steel and silver.

75. STEEL BRIDGES—American Institute of Steel Construction Inc. Brochure discusses economy of steel, erection, steel decking, aesthetics, welding and composite design in first half. Second half is devoted to examples of selected typical details showing solutions that have been used for some of the more troublesome problems encountered in steel bridge design.

76. COATINGS—Furane Plastics Inc. Flyer EP-58-28 gives specifications and details on line of Epocast coatings, sealants, adhesives and pastes used in aircraft, missile and metal fabrication industries.

77. TRANSFER SWITCHES—Automatic Switch Co. How to select an automatic transfer switch and applications of equipment are covered in booklet 596R1. Inrush capacity, continuous duty rating, rapid transfer of load, high thermal capacity and ability to withstand electromagnetic effects is discussed.

78. SILICON RECTIFIERS—Syntron Co. Revised data sheet is about Syntron selenium and silicon rectifier Station-Type Battery Charger for industrial operations requiring d-c supplies from storage batteries. Gives description, specifications and performance data for models ranging from 20 to 100 amp capacities.

79. INDUCTION HEATING COILS—L. C. Miller Co. Brochure tells of Miller Re-Coil, which makes possible the quick replacement of work coils.

80. ELECTRONIC TUBES — National Electronics Inc. Booklet gives maintenance hints for electronic tubes for equipment using ignitrons, thyratrons and gas filled rectifiers.

81. AUTOMATIC WELDING—Lewis Welding & Engineering Corp. Folder describes the Lewis Automatic Directional Control, an automatic seam following device for the self-guidance of automatic welding heads. Includes diagrams, pictures and specifications.

82. WELDING FITTINGS—Babcock & Wilcox Co. Bulletin FB-504 explains how time and money can be saved by ordering fittings and flanges which are produced to close dimensional tolerances.

83. VALVE REFERENCE—Ross Operating Valve Co. Company has 20-page, quick valve reference catalog of products. Includes most popular models in company's line, a section which presents the fundamentals of pneumatics and various applications of compressed air.

84. SUBMERGED ARC WELDING — Lincoln Electric Co. Folder 5205.-1 describes company's Mechanized Squirt Welder, tells what it can do, how it can save money and gives its specifications. Diagram gives full nomenclature.

85. WELDING MAGAZINE—Suffolk Iron Foundry Ltd. Issue of Sif-Tips, British welding magazine, Vol. 24, No. 101, includes articles on the fabrication of stainless steel dairy equipment, how to make a pre-heating stove and repairing a power station pump.

86. TIG WELDING—Linde Co. Article in

F-896 tells how Tig welding produces good welds on carbon steel pipe at low cost. Includes a chart to help one choose the welding method that fits his quality and cost requirements.

87. BLAST CLEANING — Wheelabrator Corp. Catalog 143-D is a 28-page handbook of blast cleaning, finishing and shot peening ideas utilizing the airless blast method. Describes applications, features and specifications.

88. FLAME CUTTING—Air Reduction Co., Inc. Oxygraph 56 flame cutting machine is detailed in catalog 804B. Includes many photographs, diagrams, charts and schematic drawings.

89. CERAMIC MATERIALS — Duramic Products Div. Flyer 109 is a summary of high temperature ceramic materials available from company.

90. TIMERS — Industrial Timer Corp. Synchronous Motor Driven Time Delay Timers with automatic reset can be used with photo copy, induction heating, quenching and packaging equipment, and electric welders and plastic molding machinery. Bulletin 300 includes pictures, details and specifications.

91. CABLE HANGER—Jackson Products. Sheet has picture and description of Cablehitch welding cable hanger. Includes prices and features.

92. ODOR-CONTROL — Hemeon Associates. Brochure recounts company's research in odor-metering apparatus and techniques for their applications to industrial odor-control problems. Includes pictures, graphs and charts.

93. AIR HOISTS—Thor Power Tool Co. Four-page manual 2367 features illustrations of new "H-1000" air hoists, includes tables on rate of ascent and descent.

94. AUTOMATIC WELDING — Hobart Bros. Co. Folder DM-73 describes all types of automatic and semiautomatic welding equipment. Covers power sources, wire feed mechanisms, guns, heads and controls for submerged arc and inert-gas-shielded arc welding.

95. CERAMICS — Norton Co. Technical bulletin 686 NP 1 on "Crystolon" ceramics describes physical properties of three new engineering materials which withstand temperatures too severe for metals.

96. FIRE EXTINGUISHERS—General Detroit Corp. Bulletin pictures and describes line of lightweight extinguishers. Includes dry chemical, carbon dioxide models.

97. ALUMINUM SOLDER—American Solder and Flux Co. Booklet tells and illustrates how Amco No. 2316 promotes capillary action on aluminum when soldering it.

98. DISC SUPPORTS—Nedco Co. Catalog sheet gives pictures, prices, specifications and catalog numbers of company's disc supports.

99. WELDING POSITIONER—Raco Engineering Service. Bulletin No. 100 gives specifications and speed ranges for RA-100 welding positioner for use in small weldment production.

100. TUNGSTEN CARBIDE—Stoody Co. Literature describing a new addition to the hardfacing family that is making fishing and metal cutting jobs easier and less costly in oil fields.

ADVERTISERS IN THIS ISSUE

This advertisers' index is included as a convenience and is in no way a part of the advertising contract. Although every care has been taken to index accurately, some errors may have occurred and no allowance will be made for them.

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Literature offered in ads

125. Acro Welder Mfg. Co.—Write for further information on welding machinery, engineered and manufactured to order.

126. Adjustable Clamp Co.—Catalog on complete line of "Jorgensen" and "Pony" clamps available.

127. Aeroprojects, Inc.—Further information available on ultrasonic welding without fusion.

128. Air Reduction Sales Co.—Technical literature on the "Aircomatic MIGet" for gas-shielded arc welding is available.

129. Air Reduction Sales Co.—Write for information about the Airco cutting equipment best suited for your job.

130. Air Reduction Sales Co.—"Airco Electrode Pocket Guide" describes over 100 different types of electrodes.

131. Air Reduction Sales Co.—Catalog 1318 will help you select the right electrode for your specific job.

132. Air Reduction Sales Co.—Information available on industrial and rare gases produced by "Airco".

133. Air Reduction Sales Co.—Write for literature on "Airco" arc welders.

134. Alloy Rods Co.—Bulletin HS-102 on the "Wear-O-Matic" process can save you maintenance operations in your industry.

135. Alloy Rods Co.—Write for bulletin AR-10-2 on "Arcaloy" stainless steel electrodes.

136. All-State Welding Alloys Co.—Further information on flux-coated rods; also new instruction manual available.

137. Aluminum Co. of America—Write for informative books and free loan of films on joining of aluminum.

139. American Optical Co.—Write for further information on the flexible mask goggles.

140. Ampco Metal, Inc.—Write for bulletin W-17 on "Ampco-Trode" filler rods and other electrodes.

141. Ansco X-Ray—Further information available on Ansco's x-ray film.

142. Anti-Borax Compound Co.—Descriptive circular and sample of solder and brazing compounds.

143. Arcair Co.—Information available on Arcair's metal removal torches.

144. Aronson Machine Co.—Write for further information on Aronson's "Excalibur" welding positioner.

145. Aro Spot Welder Div.—Illustrated literature on the new model 410 portable spot welder with "Ski Lift" type gyro suspension.

146. Atlas Welding Accessories—Further information available on the Atlas line of weld cleaning tools and the new "Jaw Cleaner."

147. Bay State Abrasive Products Co.—For any problem in grinding, write and experienced specialist, will give you cost-cutting ideas.

148. Becker Brothers Carbon Co.—Catalog available giving complete specifications and scaled drawings of carbon welder brushes.

149. BE-CO Engineering Co.—Write for further information on the portable welding positioner.

150. Bernard Welding Equipment Co.—Further information available on the "Shortstub" electrode holder.

151. Budd Co.—Catalog on Nuclear Systems' Radiography machines on request.

152. Calumet Paint Products—Further information available on rust preventive primers.

153. Cam-Lok Div.—Write for the new catalog No. 131-B on the complete Cam-Lok line of neoprene insulated Cable Connectors and Cable Splicers.

154. Carol Cable Div.—Information on "Dynapower" welding cable.

155. Chicago Hardware Foundry Co.—Information on "Fuse-Well" cast-iron welding rods and electrodes.

156. Columbia Electric Mfg. Co.—Illustrated catalog on tong-test ac/dc ammeter.

157. Contour Marker Corp.—Details on establishing and marking a point at any angle.

158. Contour Marker Corp.—Information and instruction book on laying out pipe joints.

159. Cullen-Friestedt Co.—Positioner catalog available on low cost welding.

160. Dockson Corp.—Welding catalog No. 58W available on the "Levermatic" welding torch and other welding and cutting equipment.

161. Drawalloy Corp.—Bulletin 355 DC provides complete information on every grade of Drawalloy welding wire.

162. Eastman Kodak Co.—Further information available on Kodak Industrial X-ray film type AA.

163. Eisler Engineering Co., Inc.—Catalog No. 93-57 gives complete information on Eisler's spot and wire butt welders and the vertical type press welder.

164. Electric Arc, Inc.—Write for copy of new brochure, "Smith-Dolan System of Low-Frequency Induction Heating."

165. Eutectic Welding Alloys Corp.—180 page "Welding Data Book" available, explaining procedures and theory of welding practice on all metals.

166. Federal Machine and Welder Co.—Further information available on Federal's "Warco Packaged Production Lines" automated production from material to product.

167. Fibre-Metal Products Co.—Write for bulletin 65 on "Supergrip" electrode holder.

168. General Electric—Write for further information on X-Ray inspection through closed-circuit television on the TVX monitor.

169. H & M Pipe Beveling Machine Co.—Further information available on H & M pipe beveling machines.

170. Harris Calorific Co.—Further information available on the new Harris 92-AR and 92-HE multi-stage metering regulators.

171. Hobart Brothers Co.—Write for information on the new 180 amp. a.c. shop welder the "Hustler."

172. Hobart Brothers Co.—Test, without obligation, the "Rocket 24" electrode.

173. Independent Engineering Co.—Further information available on transporting gases by gas supply trailers.

174. International Nickel Co., Inc.—8 page data sheet on the new "Inco-Hard "1" electrode for hard surfacing on low alloy steels and cast irons.

175. International Nickel Co., Inc.—Illustrated folder, "Now You Can Weld Dissimilar Alloys" available.

176. Jackson Products—Write for further information on Jackson's "Cable-hitch" the welding cable hanger.

177. Johns-Manville Corp.—Brochure TX-2A explains the J-M "Aluminized Asbestos Cloth."

178. Kaiser Aluminum & Chemical Corp.—Further information available on the new "King" brand welding wire for high strength welding.

179. Kasenit Co.—Descriptive booklet available on Kasenit compound for surface hardening of iron and steel.

180. Lenco Inc.—Booklet. "Reducing Costs by Proper care of Arc Welding Circuits" available.

181. Lincoln Electric Co.—For data and specifications on Lincoln's complete line of mild steel electrodes write for bulletin 7000.1.

182. Linde Co.—Booklet F-1174 available on "Oxweld" flame-cutting torches.

183. Linde Co.—More information about the "Purox W-200 Starter Set" and name of your local supplier.

184. Linde Co.—Write for further information on the new "Sigma ST-2" hand welding torch.

185. Liquid Carbonic—Information available on "Liquidweld" torches and "Do-It-Yourself" kits.

186. Lummis Mfg. Co.—Write for catalog on "Key-Bak's."

187. Magnaflux Corp.—To find out what Magnaflux Test Systems can do for you write for a meeting and idea session with an experienced Magnaflux engineer.

188. Maitlen and Benson Inc.—Information on "Wypo" cutting and welding tip cleaners available.

189. Merrill Brothers—Further information available on material handling devices.

190. Messer Cutting Machines—Write for full information on Messer's line of precision cutting machines.

(Continued on page 116)

WELDING INFO-AIDS

USE THIS CARD for Literature, Catalogs, and Bulletins shown on preceding pages and for those featured in this month's ads as listed opposite and on following page

Also information about

NEW PRODUCTS described on pages 82 to 96

Every month WELDING ENGINEER lists many new catalogs and bulletins available from manufacturers. All are yours for the asking. However, this service is valuable to you only if you use it.

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★ For additional information on New Products described in this issue, circle the numbers of the items that interest you. The New Products section begins on page 82.

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Welding Info-Aids,
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Morton Grove, Ill.

Literature offered in ads

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191. Metal & Thermit Corp.—Write for helpful hard surfacing data on convenient 3" x 5" file cards.

192. Metalloy Products Co.—Testing samples of "Galvalloy" available for your galvanizing job.

193. Miller Electric Mfg. Co., Inc.—Complete particulars on Miller welders available.

194. National Carbide Co.—Information on calcium carbide available, also name of nearest distributor.

195. National Cylinder Gas—Descriptive literature on "NCG" welding and cutting torches; also the two-stage regulator.

196. National Welding Equipment Co.—Brochures available on mixing gases, regulators, and welding and cutting outfits.

197. Nedco Co.—Write for circular on complete line of Nedco grinding tools.

198. North American Philips Co.—Write if interested in distributorship of Elmet brand Tungsten welding electrodes.

199. Norton Co.—Further information available on Norton's grinding wheels.

200. Page Steel & Wire Div.—Write for Welding Wire Comparison Chart DH-1218 and submerged arc and inert gas welding wire folder DH-402A.

201. Phelps Dodge Copper Products Corp.—Write for further information on Phelps Dodge "Habirprene" arc welding cable.

202. J. C. Renfroe & Sons, Inc.—Catalog on complete line of lifting clamps available.

203. Riegel Textile Corp.—Write for further information on Riegel weldor gloves.

204. Ruemelin Mfg. Co.—Write for bulletin 37-D describing all types of Ruemelin welding fume collectors.

205. Shawinigan Products Corp.—Information on calcium carbide available also name and address of nearest dealer.

206. Shoot-A-Lite Corp.—Literature on "Safety Gas Liter" for welding and cutting torches.

207. Sight Feed Generator Co.—Write for further information on the new "Rex-arc" automatic twin head roller, idler welder and positioner.

208. Smith Welding Equipment Corp.—Write for further information on Smith's repair service.

209. Stoody Co.—Information on a new low-cost hard-facing electrode for position welding available.

210. Stulz-Sickles Co.—Write for complete details on the new inexpensive way to solve your severe abrasion problems.

211. Tec Torch Co., Inc.—Write for full information on the Tec "Visuweld" torch and other "Visuweld" equipment.

212. Tempil Corp.—Write for further information on the temperature indicating crayon for welding operations.

213. Tennessee Fabricating Co.—32 page catalog showing 400 casting designs available.

214. Thermacote Co.—Write for complete descriptions of "Thermo" filter plates and cover lens.

215. Tuffaloy Dept. of Airco—Catalog and prices available on Tuffaloy spot-welding tips, welding tip holders and adapters.

216. Tweco Products, Inc.—Write for "Twecolog" showing the complete line of Tweco accessories.

217. United Wire & Supply Corp.—"Low Temperature Brazing Engineering Facts and Data" available.

218. Victor Equipment Co.—The Victor hardfacing manual showing you the right rod to use and how to apply it is available; also dealerships open.

219. Westinghouse X-Ray Div.—Information on the full line of industrial radiographic-fluoroscopic equipment is available.

220. Worthington Corp.—Write for the detailed bulletin on the new automatic welding head manipulator.

221. Welding Engineer—Write if interested in further information on the welding market.

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First Class Permit No. 32, Morton Grove, Ill.

Welding Info-Aids,
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P.O. Box 28
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NOT GOOD AFTER JANUARY 1, 1959

WELDING ENGINEER, P. O. Box 28, Morton Grove, Ill.

Please send me without obligation further information about the following:

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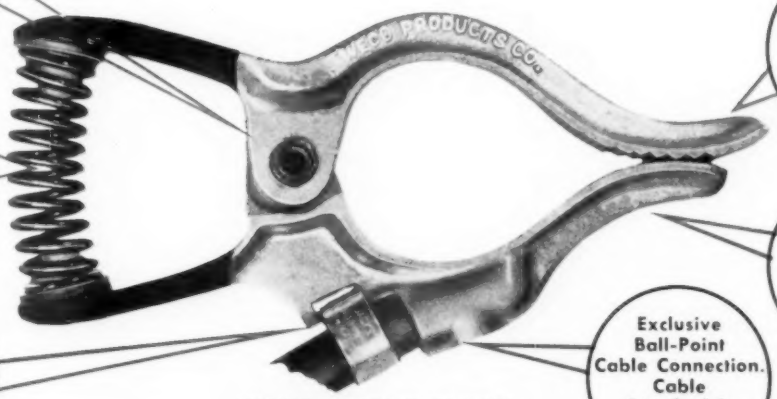
GIVES a quick, positive and portable ground connection.
INCREASES machine and operator efficiency.
ALLOWS proper placement of ground to eliminate arc blow.
MAKES holders and cable run cooler, last longer.
CUTS current consumption. Reduces power costs.

Only TWECO GROUND CLAMPS offer all these features:

Copper Hinge Pin Allows Both Jaws To Carry Current

Strong Spring Fully Insulated

Support Ring Stops Cable Strand Breakage



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Jaws Made of 98% Copper Alloy

Exclusive Ball-Point Cable Connection. Cable Attached in Two Minutes

TWECO GROUND CLAMPS
MADE IN 200, 300 & 500 AMP SIZES

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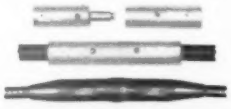

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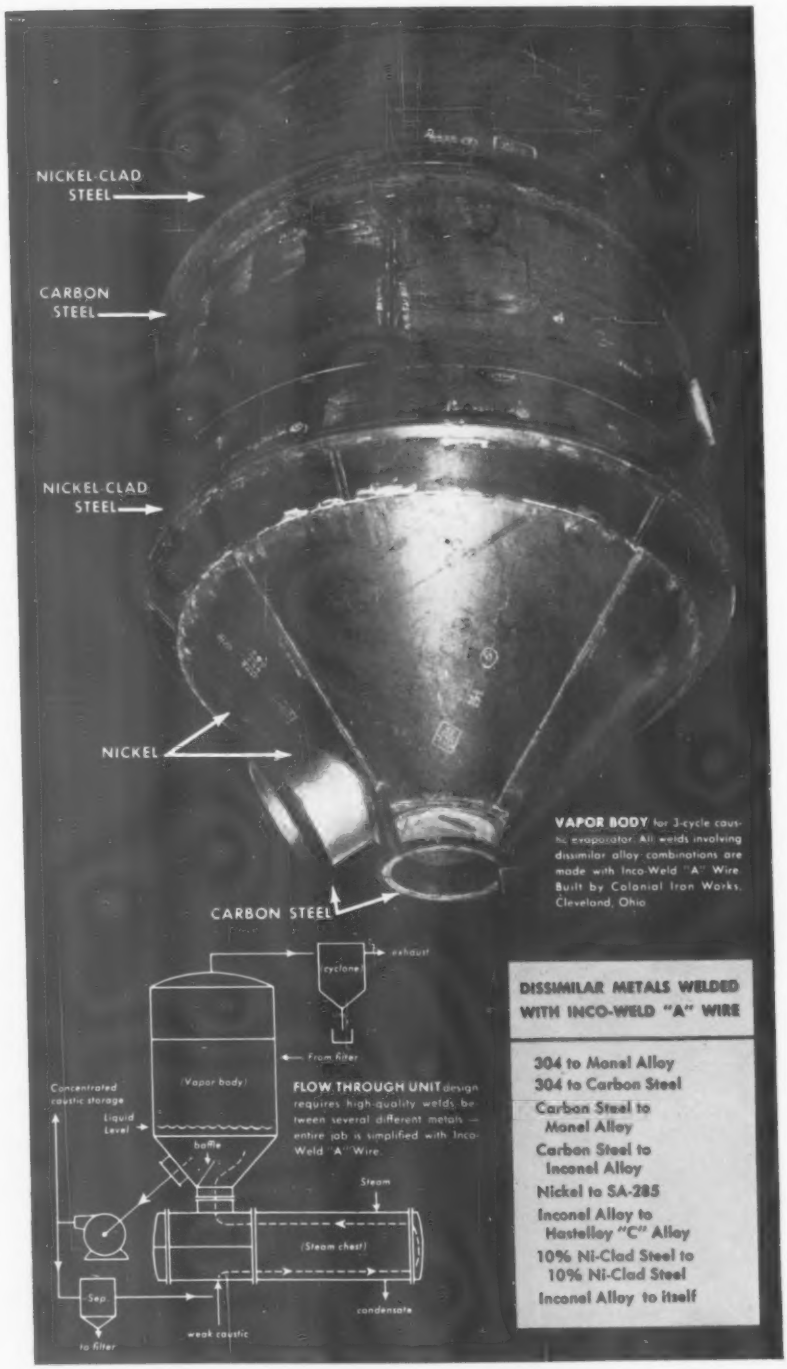
New caustic evaporator demonstrates how well one filler wire ...Inco-Weld "A" wire...joins most dissimilar alloys



DISSIMILAR METALS WELDED WITH INCO-WELD "A" WIRE

- 304 to Monel Alloy
- 304 to Carbon Steel
- Carbon Steel to Monel Alloy
- Carbon Steel to Inconel Alloy
- Nickel to SA-285
- Inconel Alloy to Hastelloy "C" Alloy
- 10% Ni-Clad Steel to 10% Ni-Clad Steel
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This new 3-cycle evaporator produces high-purity caustic—maintains purity with all-Nickel surfaces. It is fabricated of Nickel, Nickel-clad steel, and carbon steel. All welds joining dissimilar alloys are made with Inco-Weld* "A" Wire.

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Add these extras: (1) easily joins most combinations of dissimilar alloys, (2) no preheat necessary in most cases, (3) X-ray quality welds between 97 per cent of all weldable dissimilar alloy combinations (examples listed in table below), (4) good impact properties at sub-zero temperatures, (5) high stress-rupture properties at elevated temperatures, (6) Inco-Weld "A" *Wire* deposits can be age-hardened; important where super alloys are to be age-hardened after welding.

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